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REPORT

OF THE

THIRD CONGRESS

OF THE

Sanitary Institute of Great Britain,

HELD AT

CROYDON, OCTOBER, 1879,

ALSO

THE CALENDAR AND BYE-LAWS,

BEING

VOLUME I. OF THE TRANSACTIONS.

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1880.

INTRODUCTION.

THE third Congress of the Sanitary Institute took place at Croydon, on the 21st-25th October, 1879. An Exhibition of Sanitary Appliances was also opened at the same time, and continued to be on view until Saturday, the 8th of November, on the evening of which the proceedings were brought to a close by a public meeting, free to all; at which short addresses were given, on Sanitary subjects, by the President of the Congress and others. The numbers attending the Congress showed improvement upon the previous year, when the Institute met at Stafford, and the Council confidently hope that future occasions may bring together a still larger number of those who are interested, or who ought to be interested, in Sanitary subjects.

The proceedings of the present Congress were divided into sectional meetings, both forenoon and afternoon, and evening meetings. An introductory address was delivered to the Congress at the first general meeting by the President, Dr. Benjamin Ward Richardson, F.R.S., and addresses were also delivered in each of the sections by their respective Presidents—Dr. Alfred Carpenter, Captain Douglas Galton, C.B., F.R.S., and Mr. G. J. Symons, F.R.S. At one of the evening meetings Professor W. H. Corfield delivered an address, and the two other evenings were occupied by a conversazione and a public dinner.

The sections were divided into: I. Sanitary Science and Preventive Medicine. II. Engineering and Sanitary Construction; and III. Meteorology and Geology. A considerable number of papers were sent in, the majority of which were read, but in several instances it was impossible to discuss them on account of want of time. It will probably be necessary for the Council on future occasions to take steps to obviate this, either by some

arrangement of the sections, or by simultaneous meetings of different sections, when the attendance renders such subdivision possible. It will greatly facilitate matters if authors will send in their Papers sufficiently long beforehand to enable them to be properly classified and, if thought desirable, to be put in type before the Congress meets.

The Council having determined to issue a Volume of Transactions, now for the first time present the following Report of the Congress, which has been prepared by the joint Editors. In order to keep the Report within reasonable limits it has been found impossible to print all the papers *in extenso*, but when an abstract only has been given, care has been taken, as far as possible, to present the salient points clearly and the author's views accurately. It is desirable that it should be well understood that the fact of a Paper being printed does not commit the Council, the Editors, any individual member (except the author), or the Sanitary Institute collectively, to the views therein expressed: for the views expressed the author of each Paper is alone responsible.

IMPORTANT NOTICE.

THE next Congress will be held at EXETER, in SEPTEMBER, 1880. Authors who desire to read Papers at this Meeting will oblige the Council by sending in their MSS., addressed to the Editors, care of the Secretary, Sanitary Institute, 9, Conduit Street, London, on or before August 31, 1880. No Papers can be entertained after that date.

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TABLE showing the places at which the Congresses of the Sanitary Institute of Great Britain have been held; with Presidents, Presidents of Sections, and Local Honorary Secretaries and Treasurers.

PRESIDENTS.	PRESIDENTS OF SECTIONS.	LOCAL HONORARY SECRETARIES AND TREASURERS.
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1878.—EDWIN CHADWICK, C.B., Stafford, October 2nd.	B. W. RICHARDSON' M.D., LL.D., F.R.S. HENRY DAY, M.D., F.R.C.P.	WM. ELLIS CLENDINNEN. H. B. LIVINGSTON. THOMAS WOOD.
1879.—B. W. RICHARDSON, LL.D., M.D., F.R.S., Croydon, October.	ALFRED CARPENTER, M.D., CS.S.Camb. CAPTAIN DOUGLAS GALTON, R.E., C.B., F.R.S. G. J. SYMONS, F.R.S	H. J. STRONG, M.D. ROBERT HALL. SAMUEL LEE RYMER.

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PRESIDENT'S ADDRESS.

ADDRESS

BY

B. W. RICHARDSON, M.D., LL.D., F.R.S.

President.

Salutland: an ideal of a Healthy People.

On the 19th of July of this year, at the home of the Father of modern Sanitary Progress—our retiring President, Mr. Edwin Chadwick—I met the most illustrious of now living men of science. Our conversation turned on many subjects, all of which were lighted up by the entrancing exposition which always gilds the genius of him to whom I specially refer—Professor Owen. One subject peculiarly attracted the attention of us who listened to him as he expounded it. We had entered into a discussion on the question of longevity and the natural duration of life of different classes of animals. With his usual scientific accuracy and industrious research, Owen had on that day estimated from various data he had collected, the natural term of life of the curious animal, the hippopotamus. He had learned that its term of life is thirty years. He explained to us the mode by which he had arrived at that fact: how in the calculation it had been necessary to take into account the dentition of the animal; the stages of development; the natural wearing out of the teeth; the period of gestation; the development of the skeleton into the perfection of a bony fabric, with particular reference to the combination of the epiphyses or loose ends of the bones to the shafts of the bones; and, lastly, the pathological or diseased condition of the dead animal of the species that had arrived at its full longevity, in order to determine whether or not there was evidence of cause of death from disease of some particular organ, or whether there was no such evidence, but simply a history of general decay from old age pure and simple.

We were told that in a hippopotamus which had recently died, and which was known to have just turned thirty years of age,

the two sets of teeth had fulfilled their allotted duty; that the bones of the skeleton were duly consolidated; and, that the organs of the body were equally degenerated; so that death had occurred, not from failure of any particular organ, but from failure of the organic parts altogether. In a sentence, the animal had died a natural death, and the constant of the term of life of it and its family was set down at thirty years, a constant to which all the facts that could be collated in respect to this species of animal definitely pointed.

From this line of facts in respect to one type of animal life we were led to others, and the rule, laid down by the distinguished Flourens,—by which the determination of natural old age is calculated on the basis of perfected maturity,—was brought under review. The skeleton is perfected when the epiphyses or loose terminal parts of long bones are firmly united with the shaft of the bone. When the date of such perfection of development is known in the mammalian class of animals, the simple process of multiplying the age at that date by five, gives the natural anatomical life of the animal. The elephant came before us as an example. A young elephant, whose history had been related in the Philosophical Transactions, died at the age of thirty years. At that age the epiphyses of its bones were not completely united with the shafts. It was nearly but not quite matured. Multiply thirty by five, and one hundred and fifty years stand as the natural estimate of the life of the elephant; so that really an elephant might exist which had itself carried all the Governors-General of our Indian Empire. Moving from this animal of long life, we turned to the camel: to find full maturity at eight years, full life at forty. We turned to the horse: to find full maturity at five years, full life at twenty-five. We turned to the lion and the ox: to find full maturity at four years, full life at twenty. We turned to the dog: to find full maturity at two years of age, full life at ten. We turned to the cat: to find full maturity at eighteen months, full life at seven and a half years. We turned to the rabbit: to find full maturity at one year, full life at five.

From these contemplations our minds very naturally reverted to the animal—Man, to the members of the human family. Man, we learned, follows the same rule as the rest of living beings. Judged

by the same test, his full maturity and full age may be calculated with equal precision. His maturity,—perhaps not quite the full maturity,—is twenty years. His full age, therefore, is one hundred years. This is the anatomical estimate of human life, the surest and by far the best of all that can be supplied, since it defines a law irrespective of and over-riding all those accidental circumstances of social and physical storm and strife, which may interfere, and indeed do interfere, with every estimate based on the career of life itself, as it is shown in the ephemera by and through whom it is phenomenally demonstrated.

This lesson told with singular felicity of language from two masters of science,—for Owen never orgot Flourens,—struck Mr. Chadwick and myself with singular force. On a surer basis than we had ever trod, it corroborated a view we had ourselves promulgated from entirely different stand-points; and it further corroborated a similar view which had been advanced by our eminent friend, Dr. William Farr. We were led, in a word, once again, to the inevitable conclusion that man, even in this stage of his probation on the planet, is naturally destined to walk upon it, endowed with sensibilities of life and intelligence, for a period of one hundred years, and that until he realizes this destiny practically, he is in value of physical life actually degraded far below his earth-mates, whom he designates the brute creation, and over whom he presumes to exercise his, to them, almighty will. The constant of human life is naturally one hundred years.

In this statement, I, for one, gathered up, on the occasion referred to, something never to be forgotten. The constant was before us in all its truthfulness. But more remains. Because the fulness of age is one hundred years, it is not an essential that death shall immediately crown the advent of that fulness. To certain parts of the scheme of natural life there is a boundary. The period of maturity of development has its boundary of twenty years, when the body, as Flourens says, ceases to grow; but if, in the ordinary sense of the term, it ceases to grow, it does not cease to increase; its nutrition improves and perfects for twenty years more at least, and then has only reached its completed physical condition. It should never from that period gain in weight, and for a long time it should not lose. It goes on now through a third period, which

Flourens admirably calls the period of invigoration, during which all its parts become firmer, all its functions more certain, all its organization more perfect; and this period covers thirty years. At seventy old age begins; the *first* old age in which naturally the fruits of wisdom are most bountifully developed, and which lasts from fifteen years to twenty, to mellow down to a period of *ripe* old age, commencing at eighty-five years and lasting fifteen years more, *i.e.*, until the constant is attained.

And yet there need not now be death; for though, as Lord Bacon has said, old men are like ruined towers, and though, as Flourens has quoted, youths live in a double sense, with forces in reserve and forces in action, *vires in posse et vires in actu,* the *radical* forces and *acting* forces of Barthez, while old men live only on the forces in action, "*vires in actu*," possessing no reserve, it is wonderful how the forces in action will continue after the reserve is withdrawn. This kind of half-life has continued unquestionably many years beyond the fulness of age, both in man and lower animals, and to give it twenty years beyond the natural hundred is to be just without being in any extreme sense generous.

In this anatomical reading of human life we see the growth, the increase, the invigoration, and the solidification, of the body: we see the life with its reserve on its two threads; the life without reserve on its one thread; and, finally—the force in action being withdrawn—the life ceasing, and the earth, proclaiming her mastery, dragging the actor as unconsciously to herself at death, as he was unconsciously projected into the world at birth.

All through this presentation of natural fact, moreover, there runs another physical truth. Death is centripetal action. Those two birds on the wing which up to heaven's gate sing, are physically filled, like the gyroscope, with the *vires in posse et vires in actu*, powers in reserve and powers in action. Yon wanton sportsman liberates a ball which pierces one bird, and the earth claims its prey. The living gyroscope falls. The fellow bird escapes. In time, it fails to rise the same height, its force in reserve being withdrawn, but its force in action remains, and it lives on. At last, some trifling extra call upon it is final, and the triumphing earth brings it down to itself. That first bird fell from an interference with its life while yet it had its two powers: that second bird fell from failure of

powers at different periods, but from the same inevitable, always present cause, the attraction of the earth.

The same is true of men also. What we call death is gravitation: what we call disease, is some accidental shot inflicted, it may be, while still the self-resistance to gravitation is in operation: what we call natural death is the gradual over-weighting, at different periods, of the natural powers, reserve and acting, by the persistent force that bears us down. We cease to grow at a certain stage of our life, because of the resistance of this downward force: we cease to increase in size from the same cause: we consolidate in structure from the same cause: we bend in old age from the same cause: and we die from the same cause. Every step has practically been a death from the same cause.

As these facts appear, we are inclined to ask, How many of all men and women projected into life and charged with the reserve and acting forces,—how many die with those forces intact up to the time of death, and how many with the acting force alone in operation? How many, if I may use the simile, die on the wing, fall headlong to the earth, shot by some wanton shaft that need never have been discharged? How many sink naturally to the earth from her final and gentle embrace?

The answer to this question appals the mind. The answer rings out:—Man reckless of life! every lower animal you do not immolate beats you in this! Man! civilized as you are proud to say, you have never yet given life a chance! Man of reserve and action, you die on the wing more certainly than the birds of the air on which you practise your fatal sports! Man! you die within the first part of the second third of your natural life. Let the elephant die at sixty, the camel at sixteen, the horse at ten, the dog at four, the cat at three years, and the rabbit at two years, and they will then match you in the value of life you train yourself to possess. Man! endowed with knowledge of science, who can divide the year into seasons, and history into centuries and eras; who can calculate the courses of the planets and predict their crossings and shadows; weigh the earth, as in a balance, and predicate storms and tempests, you have yet to learn that, with the precision that regulates all these things, your own life is meted out,—that such a childhood means such an adolescence, such an adolescence such a maturity,

such a maturity such a decline, and such a decline such a period of death.

Nay, more; man so endowed does sometimes see by adventure, as it were, the whole law fulfilled without his studying for it or expecting it. Some individual lives the whole natural period of life, exceptionally, as an elephant, a horse, a lion, a dog, a cat lives it ordinarily, and thus, by seeming adventure, proves the truth of the law which has been laid down. The event, perfectly commonplace in the case of a lower animal,—a dog that lives to ten,—is a perfect marvel, when it happens, to a man who lives to a hundred years, the equal term. To see a centenarian we travel miles and miles, and discuss the time of his birth with keenest criticism, so truly unnatural is the state of things under which human existence at present is unfulfilled.

The question arises, how long is this condition of affairs to last? No more vital question stands for solution at the bar of civilization.

The day, in fact, has now arrived, when the cultivation of life by the cultivated of mankind is the primary art for the continuance of the cultivated. If the civilized world would continue in the ascendant, it must learn to live. An average life of forty-one and under favourable circumstances of forty-nine years, with a world of disease and death up to that period, and a scattered struggle of the fittest for an exceptional existence into ripe old age, cannot maintain the relative efficiency of any nation, except in a world universally and equally bad. Ingenuity itself is bounded by life; device by faculty for devising. Weapons of precision give us victory over savages. Is that success? Weapons are made, not begotten, and savage tribes, fierce for contest and unscrupulous, may readily learn to apply what the civilized man has devised, and in repetition of history, make easy work of the short-lived civilized.

We Sanitarians are forced by our studies to recognize these truths. We exist, if we exist for any great purpose at all, to protest against the casting away of nearly two-thirds of the life that is meted out for civilized man. We exist to protest that it is not a scientific civilization which can permit such reckless waste of the gift that stands above all values and qualities; and our protest is the more earnest as we detect that the waste which we observe, is

actually not at the time of life after the prime has been reached, but is most destructive in the very budding of life, and continues at the intermediate stages between the period of budding and the prime.

To speak in plain terms,—and if ever plain terms were demanded, they are demanded now,—the world in this matter of life and death has, by daily observation of the phenomena, got into the habit of looking on wrong as right, and on what is practically suicidal death as death that is natural. It is a strange fatuity. If we were, for a short time, to see the lower domestic creatures under the same curse; if we were to witness horses enjoying ten, dogs four, and cats three years, as an average duration of their lives, we should think a persistent murrain had come upon them, and that, in relation to these useful domestic animals, the whole course of life had undergone a deteriorative change. Yet that is what, in effect, we are observing amongst our own kind, so that the Sanitarian in despair may exclaim: Oh that man were as wise as the horses and dogs, that he might have the bounty of life which the Allwise has awarded to him as the natural bounty, extended and beautified and exalted by the intelligence with which he is endowed above the beasts.

I press the question. Why should we, of all animals, perish as we do in the first part of the second third of our natural career? Why are all the doctors of the human species, with their flowing knowledge and consummate skill, to carry out cure—why are they so set at naught, that the lower animals, who have no advantage of their services, have a higher vital possession than man at their command?

The answer is told in a few words. It is that we have never as a community let ourselves study the question; have never, in truth, looked at the facts, plainly as they stand forth.

And now comes another question—Knowing the facts: knowing what is the natural term of human life, can mankind learn to attain that term? Can man learn to live his hundred years, with a prospective chance of extension to a fifth of a century more? Instead of being cut down at the moment when he has filled his intelligent mind with the learning of his time, and when his knowledge is just becoming transmutable into wisdom, can he go on, an intellectual being, brought to the highest pitch of

usefulness? Can he go on to the full term of his natural and prospective course?

I do not dare answer that question on my own account, because it is answered for me. He who gave the life has answered the question. He has written it for us in unmistakable language. He has shown all of us who can read His natural designs, that it is one of them that man may live the term if he will. Free-will making a man a free agent, is all that is set above the natural law, and free-will is natural law too, governed by intelligence which is as natural, and is as freely supplied.

How, then, shall civilized man live, that the natural term may be found?

There are many modes of replying to this inquiry.

I prefer, in the reply I shall venture to offer, to frame what I have to say in the most easy form. I address you, a learned body of men and women; but I remember, at the same time, that through you I am addressing thousands also who will read what you hear; many of whom are most easily approachable by a description, which will hold the imagination while it conveys the moral.

Permit me, therefore, after having built an ideal city, now to create an ideal people that shall show a model longevity; a people that shall have an ordinary term of life of one hundred, and a prospective term of one hundred and twenty years.

If in this attempt I say many things that may seem strange let it be understood that I am treating of a time supposed to be nearly two hundred years in advance of the present, when many views and thoughts will have changed in all parts of the world. Let it also be understood that I am obliged, in order to show what is possible, to advance a theoretical position, which is not at this period altogether possible. At the same time let it be further understood, that what I suggest is substantially necessary, in order that the result to be arrived at may be attained. I have, as it were, counted out all the conditions that are essential for the attainment, and have weeded out all the conditions which would stand in the way of the attainment, so as to put forward a standard towards which to march at all, is to march in the successful direction, though the goal be not easily reached.

SALUTLAND.

In order to carry out my design, permit me, in imagination, to convey you into a future age. Let the bells be ringing in the fiftieth year of the twenty-first century of the Christian era. Let us, still speaking our Mother English tongue, travel by readiest and quickest transit,—in an ærial ship, if it pleases you,—to a point of the earth's surface lying to the extreme south of that region which Mr. Hepworth Dixon, in one of his prolific and striking works, happily designated as New America. There land with me in an independent Commonwealth to which has long been given the name of Salutisland, or more commonly Salutland.

In our own country there have been stupendous changes, moral, social, political, between this day and the first day of January two thousand and fifty. We are no longer in England the short-lived people that we were. It is nothing remarkable in these days of the twenty-second century, to see in our own towns and cities many members of both sexes who have attained one hundred years. The dispute is whether any man has actually lived one hundred and thirty years; and when such an event is recorded publicly, a still existing Thoms is ever ready to fly to the registers of birth and criticize them with an unsparing criticism. But we have heard recently of this people in Salutland, who think little of such an advance of life, of many living there who have attained one hundred and twenty years, and of a few who, having attained a hundred and fifty, well recollect conversing with persons who were living at the time of that Zulu war which ended in the capture of Cetewayo, and who remembered the introduction of telephonic messages.

Salutland, in the middle of the twenty-first century, has been in existence over one hundred years, but it has developed so quietly, and has done so little to make a furious noise in the world, that its rise and growth have received but small attention. It has never once been engaged in war; it has produced neither general nor admiral; it has never asked permission to send a minister or ambassador to any foreign State, and it has never received such a functionary from other States. The most it has done to become known abroad lies in the fact that it has produced some remarkable

painters, sculptors, architects, musicians, and poets, with many men of distinguished ability and originality in science and literature, The names of these illustrious men are well known, and in the galleries of art and scientific academies, in all parts of the world, they are recognized as citizens of Salutland. Beyond this, their country has been, until recently, a neglected and isolated region.

Lately Salutland, owing to the great longevity of its people, has become the subject of much conversation in the old world, so that at last it is a fashion to visit it, in vacation times, in order to learn the means by which so strange a healthiness has been secured. Men and women, it is reported, have in this favoured community reached generally to the perfection of natural life, being as fortunate in this respect as the more favoured lower animals that are permitted to live their natural term. A learned writer has compared the Salutlanders to those happy, powerful, and beautiful Macrobians of whom Herodotus wrote as of a people who had attained, in his day, the art of living one hundred and twenty years. Another learned author, extending his views as to the phenomena of life, after visiting the Saluts, has announced his opinion that the period assigned for the longest life there had been much under-rated; that many of the inhabitants of Salutland, even at the age of one hundred, have a youthful appearance, and that the old hypothesis of rejuvenescence is being there practically realized.

In addition to these inducements to visit so favoured a land, it is told that the people of it are as beautiful as they are long-lived, as healthy as they are beautiful, and as happy as they are healthy. Some Spaniards visiting Salutland, and observing with admiration and wonder the exceeding comeliness, refined manners, and good nature of all they met, conceived the charming fancy that the term Salutland came from the salutations of the people, instead of from their healthiness and strength. Whereupon one of the wise men of the country told the strangers, as he corrected them, that after all they were right, since health and good breeding were synonymous, and quoted a proverb, common amongst his people, that health and honour go hand in hand; implying that the man who is of perfect soundness in body and in mind is of necessity a gentleman, and

must, on all occasions, do what is perfectly worthy of that blessed and blissful estate.

So in this year of grace two thousand and fifty, Salutland is the land of promise, and we are there to see it for ourselves and learn its life. We have reached the place at last which the Israelitish seer and singer sang from afar :—"Where there is no more an infant of days, nor an old man who hath not filled his days."

THE POLITY OF SALUTLAND.

You will presume that, as a beginning of our travels, we shall go at once to the capital of the nation. That is not possible, for there is no capital. There is a beautiful country, three hundred miles long, and in many places two hundred miles broad, inhabited by seven millions of people, and possessing the most beautiful cities; but there is no single city that claims to be called a capital. All cities have an equal right and an equal importance. But where, say we, is the centre, or seat of government? Is there not in that sense a capital? Not at all. There is no seat of government, and yet every city is such a seat. In the early days of the Commonwealth, the wise, matured men, who had passed the age of ambition's fool, came to the conclusion that it would be dangerous to concentrate any ruling power in any particular city or centre. One of these wise men, Menander St. Just by name, read to his compatriots an essay on over-legislation, written in the nineteenth century, and attributed generally to the descendant of a noble English house who dared to think for himself, in which essay it was expounded that many laws make many lawless. Backed by this fine essay, St. Just prevailed upon his countrymen and women, for women were from the first admitted into equal conference, to make every important city an equal centre of power and influence. The advice was taken; and in order that no city might even claim priority in history, the new law-makers withdrew into the wilderness, and there, in an almost inaccessible place, amid dry rocks and on a mountainous ridge, held their original conclave. That spot, now enclosed and immortalized by a fitting inscription, telling to what honoured use it had once been applied, is held in reverence as a place on which the builder must never apply his skill. It is called "The Silent Birth-place," and no stranger is expected to

leave Salutland without visiting it. One by one the statues of those who consecrated it as the centre of law and order and holy life for the land, have been placed in the enclosure; and as it is a test of greatest work to be permitted to design and carve each statue, The Silent Birthplace is indeed a gallery of art well worthy the anxious stranger's pilgrimage.

The wise men and women who met in that silent birthplace, and there and then for the only time animated it, went further than to prohibit a centre of government. They had travelled, and for a time sojourned, in a neighbouring community, where, every fourth year, the people raged about a new ruler. The impressions they had thus obtained excited some to envy, others to scorn, and others to wisdom. The ambitious and crafty thirsted to imitate the neighbouring and powerful confederation; the disappointed and scornful raised their voices against the proposal, and denounced the plan as equivalent to setting up a golden calf or a brazen image, with many other equally violent tropes and denunciatory epithets. The women listened. At last, when order prevailed, one of the so-called wise men or fathers, Nicholas Northstar by name, and who, like Menander St. Just, played a conspicuous part in the formation of the Commonwealth, rose and reasoned:—"Why," said he, "should we who have refused a capital, think of setting up a ruler to guide us, and so open the door to every man's gaping ambition? Let every house be a capital, every hearth the place for a president's chair, and every man and woman be equal rulers there. Then all that is needed will be achieved. Thus consolidated, a few common laws for the common health and the common wealth,—for health and wealth are one,—will make us a model and perfected people."

The universal assent which followed upon this timely counsel, led to the framing of such laws as were considered at that period most suitable for the wants of the community. But as time might require changes, it was decided that, while every city should govern itself, there should be held every five years a national conference, never twice consecutively in the same place, at which all existing laws should be read or proclaimed, in abstract or detail, and such changes or additions be made, during the sittings, thereto as should seem necessary for the general good.

In this manner, each town that can boast a sufficient population,

and a sufficiency of accommodation, becomes in turn the hospitable centre of the quinquennial gathering. Each town so honoured is, from the time of the event, a place of local mark and history. On a magnificent pillar of granite, it records the event, and is henceforth proud that it is one of the "obelisk cities" of the Commonwealth. The Saluts date many of the incidents of their lives from these representative memorials.

The absence of a seat of government, and of all centres for cabal and plots of politics, does away altogether with professed politicians, a condition which these wise people very much appreciate. They have a singular idea, gathered from what they have learned among political nations, that politics is a sort of quackery. When, therefore, they see one of their community getting up to make violent political speeches, they treat him as a harmless lunatic if they think him sincere and single-minded, and as a dangerous one if they guess that he has any selfish or personal intentions or aspirations in view. The result is that would-be political men are all in the shade. They are called after a term gathered from the old-country, "Coventryites," and they are so universally recommended to go to the place connected with their name, that they give very little trouble indeed. As to the practice of ruling by parties, and balancing one set of ruling spirits, each equally ambitious to show how they cannot do it, against another, by which some ancient people were at one time hanged, drawn, and quartered at regular intervals, they look upon that with absolute wonder, and as almost too incredible to be conceived in connection with the normal existence of reasoning minds. It suggests to them a spectacle of incessant civil war, bloodless but costly, devastating, maddening, and mortal. Certain it is, they maintain, that with so much political strife it would have been utterly impossible to have attained the length of days, riches, and honour of Salutland.

Surprised as we may be at this revelation, our wonder does not diminish when we discover that the people we are among making it a primary excellence to carry out that cardinal Christian virtue, "fear God, and love thy neighbour as thyself," possess as few lawyers as politicians. They have a proverb which says, that what politicians make difficult lawyers make inexplicable; and they have an idea which practically surpasses the proverb in effect, that when

two people determine to go to law, one of them is of necessity mad, and, as a rule, to which there are few exceptions, both. They had a sanitary scholar once amongst them who did much to demonstrate this view. By an elaborate and unanswerable series of proofs, he showed that the tendency to enter into litigation runs in families, and that almost all the members of families affected, are unusually short-lived, and come to grief in some form or other, unless they reform their ways. These facts, which might easily be discovered in other countries, made the Saluts think that such a state of things must be very unhealthy; so step by step legal work as a profession came into disrepute. In place of long trials and learned advocacy, men began to submit to simple arbitrations, in which they spoke or wrote their own sides of the question, and agreed to submit to the decision of the arbitrators, who took from them no fees, and who had no interests in the results of the suit. As by magic, under this simple and natural process, the varied passions of hate, and revenge, and fear, and rage, and falsehood, passions which are the deadliest of poisons in a man, or a nation, subsided, and therewith, except in the case of the construction of a deed of gift or will, legal interference became tabooed and out of date. Why, say the Saluts, should one man feed on the passions of another? He must be poisoned who lives on poisoned food.

It must not be supposed, however, that there is any disregard to order and public law in our ideal country. There are administrators of order according to the public will, and officers of it. In all communities under a thousand of population there is the magistrate or Commonwealth Censor, who adjudicates on appeals made to him on behalf of public justice. The Censor is a man who has reached forty years of life, and in every community it falls in order of age to one man to hold this office for one year, if he be himself of good and worthy repute. When the community numbers over a thousand, one more Censor for every thousand persons is added, so as to constitute a sufficient tribunal, while in urgent cases it is permissible to summon a larger council from those who have previously held the office of Censor. Thus it falls out, that every man in the State has, of necessity, without election or any caprice of the kind, to expect to perform the highest function connected

with local self-government; and as he, who will sometime be called upon to administer justice, must needs be himself pure of heart, the fact of the responsibility that will come on him, helps to keep him strong and resolute in virtue. Beneath the Censors are, in like manner, impressed a sufficient number of officers, composed of men over twenty and under forty, who carry out the instructions of the Censors, and bring before them those who are, for the time, under judgment. No man escapes the single year of this duty.

Where there are no politicians nor lawyers, there is little need for armed men. Carrying out to its fullest possible development another cardinal Christian principle, "peace on earth, good will towards men," the Salutlanders maintain that a people which picks no quarrels has none, and, enigmatical or visionary as this may seem, they find it true. To spend money in making vast engines for the destruction of human life, is to their minds, not insanity merely, but the greatest of crimes, excusable only by the direst necessity. They who kill, die. What avails it, say they, in a little speck of a planet like this, that one nation should strive to force its own particular views on other nations? And where, they ask, is the work of destruction, once on foot, to end? If men can be found wicked enough and clever enough to blow up a great citadel, and such crime and such skill be admired, why should it not come to pass that some men, still more skilful and powerful, should combine to blow up the whole globe and all that there is on it? Apart from this, they argue that armed men make disease, which is quite enough to exclude such men as a class from a model healthy people. Armed men are the picked men of the community; they are taken from humanizing and peaceful occupations to follow a craft that can rarely be either the one or the other. If such men have nothing to do, they lead an indolent life, gilded with a false conception of authority and power, which is not wholesome as an example. If they are called out to fight and die, they are the best physical blood of the nation thrown away. What the wars of Napoleon did for France, great as was the glamour of Napoleon the Great, is enough for the Saluts in evidence of bad health from brilliant warfare. What befel the Romans in the time of Hadrian, who had to cut off the limbs of his great empire in order to keep its heart alive, is enough for the Saluts in evidence of the danger to

health of human lust after human dominion and majesty and power.

The destroying professions possessing no strongholds amongst our model people, it follows that even the healing professions must also be limited. The fact is so. It were not a Salutland, in any true sense of the term, that should demand, as we have it, one professor to a few hundreds of the population, to soothe and heal up the diseases of body and mind. In Salutland there are no healers as distinct or salaried classes. In the first place, there is little necessity for them. In the second place, on the subject of the laws of life and health, and the construction of the house of life, every person, male and female, has a sound education, the study of this subject being primary in all schools and families. And, in the third place, the principles of modern science are taught with exacting rule. Thus all the men and women can, to a large extent, take care of themselves and theirs. At the same time encouragement is given to an order of men and women who, combining the offices of minister and physician, and cultivating their minds in a highly intellectual degree, are greatly venerated and esteemed. The women so cultivated are ready to give aid and assistance to other women in great pain and peril; and the men are consulted, if the term may be used, in all circumstances of serious danger to health and life of a public or personal kind. But none of these are paid for their services, and indeed to offer a fee would be considered the greatest of insults, the idea being that to pay a man or woman for the divine service of relieving affliction, either in mind or body, is to spoil the divinity of the act altogether, and to bring it down to the lowest level of the lowest humanity.

These administrators may follow, therefore, some other occupation as a means of livelihood; or, they may be what we would call persons of independent means; or, as is common in many towns, they may receive an endowment which has been left to maintain them in their dignified pursuits. They are still called Doctors—learned—and they are indeed true physicians, students of Nature, faithful ministers of body and mind. They consider no honourable labour too low that is connected with the collection of knowledge, no labour too hard that is connected with the administration of what is good.

These are some points in the general polity of our ideal people. Let us look now more closely at their social and domestic life, and at themselves as a community.

SOCIAL AND DOMESTIC LIFE IN SALUTLAND.

The first thing that strikes us is the number of their fine but moderate-sized cities. Modern Babylons, like London, Pekin, or New York, are unknown amongst them. It is considered that a centre of life containing, in a limited space, more than a hundred thousand people is a danger, is in truth for all purposes of health unmanageable. Death, they hold, is the shadow of birth, and if large communities be admitted in which people are herded together, the shadow may be calculated with as much accuracy as an eclipse. Five separate dwelling-houses to an acre of land, and five persons to a separate dwelling-house, is the densest population allowed. The houses, large and small, are all built, with varieties only of artistic design, on arches which raise them from the ground; the bedrooms are disconnected altogether from the living-rooms; gardens are all around, and gardens are on the roofs. In the midst of the towns the eye is struck with the cultivation of fruit trees that prevails. Every town of Salutland might be called, as ancient Norwich once was called, a town or city of orchards. Throughout all the country the land is under cultivation of the most perfect kind for cereal produce and fruit and vegetables. Through this cultivation there are interspersed magnificent parks and glades, in which harmless animals of the most beautiful kind are free to wander. Every tameable animal is there, and all animals are objects of singular and lively interest. The rivers and lakes are filled with varied kinds of fish, and every sort of bird that can be collected, retained and naturalized on the land is also to be seen. But what strikes us as most curious is that this living magnificent creation is obviously preserved mainly for pleasure, and instruction and beauty. There is no idea of preparing any member of it for slaughter for any purpose, except for decrepitude, accident, or positive necessity. A man, woman, or child, who for wanton pleasure should hunt down or torture one of the inferior creatures would be cast out of society, while the idea of having the dumb creature killed, and hung up in open shops to bleed and be

quartered and cooked for human beings to live on, would be treated with as much disgust as we should now treat the practice of the owners of those African shambles for human remains, which Professor Huxley, in one of his most charming books, has so faithfully re-copied to illustrate the history of a past civilization.

Animals are, notwithstanding, still used by our model people. Their fleeces are used for clothing, their milk for food, and many of them are made to work. The elephant works with an intelligence and skill that is almost human, and with a power that is superhuman, so that he is one of the most useful and faithful and best-beloved of all the lower animals in the land. He is the rival of the horse, which is also much cared for, and is bred in a state of great perfection for bearing the rider, to which duty he is mainly consigned. The horse is in much request, for all persons in Salutland, male and female, are consummate in the saddle; their country, which contains vast and fertile plains, divided by splendid roads, and their atmosphere which, except during a short periodical rainy season, is mild and dry, being remarkably suitable for horse exercise.

The roads leading from one part of the country to the other are maintained in the most perfect efficiency, smooth in all parts, and dry as our best asphalte of to-day. Transit along these highways on horseback and by velocipede has supplanted most other modes of personal conveyance. The lines of railway, once so general, have lapsed now into conveyance for heavy goods, mainly. The cost of coal has rendered steam-locomotive power very limited, while aërial locomotion has replaced steam-propelled carriages in a marked degree. But that which has effected the greatest change in respect to locomotion, has been the facility with which persons in all parts of the Commonwealth can converse by telephone at any distance from each other. Separation is not really felt as with us now, and the act of journeying at a pace above forty miles an hour is considered an unnecessary expenditure of means and physical energy.

Taking Salutland, as a whole, it may be compared to one vast garden. " It is a return," says one of their writers, " if it be not presumptuous to say so, to the ideal of a Paradise, in which all that is unclean is cast out."

The cities and towns are so constructed as to convey to the

observer some classical conception of the illustrious past of the world. In favoured spots for the adaptation, great and wonderful cities have been revived in their pristine splendour, and with rigid truthfulness. Athens, with its Parthenon and all its ancient glories, lives again in this new world, on a seaboard equally beautiful. Paris, Rome, Cordova, and Salerno are recalled as they were when their learning was the glory of the world. In a new Jerusalem the Temple of Solomon, true to every inch of design and measurement, invites the curious. A modern Pisa has its leaning tower, and many of our own beautiful cities, such as Bath and Edinburgh, or historical towns such as Stratford-on-Avon, rise before us in exact form and character; London has its miniature.

But as we enter these dwelling-places we lose sight of all that is either barbaric or sorrowful. Those four gates of our present cities of destruction,—the asylum for the insane, the workhouse, the gaol, and the sick hospital,—are as foreign to the inhabitants of Salutland as the four gates of the walled cities of olden time are foreign to us at this hour. In some of the exquisite gardens outside the towns there are a few houses, not distinguishable from others, to which those who suffer from accident or disease are, if it be necessary, borne, and in which, with all that can greet the eye and make the heart light, these, hardly unfortunates, are fanned back into radiant health. There are also, in every city, a few houses, undistinguishable from the rest, in which those who are not able to provide for themselves are comfortably lodged as children, young or old, of the Commonwealth. So the sick hospital and workhouse are replaced.

As to the other two gates of our present cities of destruction,—the gaol and the lunatic asylum,—they are disposed of together in a manner which deserves a brief description. In the course of scientific development, the philosophers of Salutland were led slowly to the demonstration that, in every case, crime and insanity are synonymous psychological conditions. Every criminal they found was insane, and every criminal act was an act, as it always proves itself to be, insane of itself. They looked back upon the history of the past world, and they discovered that some of the most remarkable men, in respect to mental capacity, were still insane. Peter the Great, Napoleon the Great, Alexander the Great,

not to name a hundred more, were, with all their greatness, insane; their very insanity, to some extent, being the sustenance of what the weak would call their greatness. Descending from the highest insanities to the lower and the lowest, they traced out perfect analogy. They detected that on matters of crime many men and women might be mad, while on other matters they were sane, and even capable of performing good and useful works. Thus, analyzing natural facts, they became in time bold enough to act on what they had learned. The man who can commit a crime is insane, and must be treated accordingly. To punish such a man in the ordinary meaning of that term is to try to cure one crime by committing another, which is absurd, and would be an indication of general insanity. So the insane man from crime is put with the other insane. He is moved with them to a separate colony called "Hopeland," where, according to the nature of his offence and the character of his affection, whether it be deeply hereditary or not hereditary, and so on, he is subjected to a seclusion in which he can do no one any harm, and to such supervision and improvement as may render him fitted to re-enter society. His banishment is softened by the permitted visits of friends, and when recovery is completed he is free. But in confirmed cases where the criminality is incurable, the law is inexorable: incurable madmen and madwomen, treated with all imaginable care and consideration, are retained apart to the end of their lives. They must not corrupt others. Most of all, they must not be the fathers and mothers of a new progeny, corrupted by that most silent and potent of all corrupting influences, hereditary taint.

THE PEOPLE OF SALUTLAND.

From the social life of this ideal land, we may turn to the people who inhabit it, and who have proved the truth of the anatomical argument as to the natural constant of human life. They are so advanced, in this respect, that by fifty to sixty years of expected life, they are better off than we are, who live to-day.

As the people pass before us while we move in their midst, we are fain to divide them, after Flourens, into types of five ages. Their first period of life extends to ten years, in which dentition is perfected,—the age of infancy. Their second period extends to

twenty years, in which the development of the skeleton is completed,—age of adolescence. Their third period extends to forty years, in which the increase of the size of the body terminates and the whole organism is completed,—age of manhood or womanhood. Their fourth period extends to seventy years, in which the whole of the internal organs are made firm and invigorated,—age of maturity. Their last period extends from seventy to a hundred years, and is subdivisible into two parts,—one reaching to eighty-five, the *first* old age; the second from eighty-five to one hundred or beyond it, the *ripe* old age, or *sacred* age.

WORK IN SALUTLAND.

In each of these ages the body and mind have their natural work, and rest, and play. The first age is left to be devoted entirely to active physical growth; not a strain or tax is ever put upon it that approaches labour. "To grow is to labour," is one of the mothers' maxims. "It is time to begin to earn bread when the teeth can chew it," is another similar homely proverb. So the children grow up, not in idleness, but in directed pleasures, which tend towards the acceptance of work and play as varieties of one and the same pastime. They are allowed from ten to twelve hours of sleep; they are led into games and exercises which develop the physical and mental powers; and their only lessons are in practical and amusing tastes in languages and in music. Their own native tongue, still English, and even more purely English than the English of England,—as is natural in a concentrated community, which has become more closely intermixed,—is taught in the purest form of accent and style, as a first consideration. After that, other languages are taught, conversationally, from their roots, and all the languages of Indo-European origin are thus early impressed, and easily impressed, on the mind. Music is taught as naturally as language, in fact as a part of natural language, the notes running with the alphabet, the chords with syllables, the melodies with sentences. Every child can sing. The birds of the forest, the morning stars that in their courses sing together, are not more harmonious than the children of Salutland.

The result in after days is that every adult remembers the child

life with pleasure and profit; that life has been based on happiness, and life so based can scarcely ever be mournful.

The second, or developing stage of life, is also little oppressed with work. A young old man or woman in Salutland would be looked upon as a deformity. The home life is exclusively cultivated. To send boys and girls into cloisters and barracks, to commingle in herds, and exchange their own crude ideas and sentiments as current coin, would be esteemed a parental crime, carried out to excuse parental care and parental responsibility. The young of both sexes during this age go to the academies, where they are taught together, a plan which refines the boys and strengthens the girls. The education is never forced. Hard examinations, prizes, rewards for work, all these excitements would be held as mentally poisonous, mere excitants of local emulation, to the exclusion of the general. "It is honourable to learn," say the Salutlanders; "it is more honourable to be learned; it is most honourable to communicate learning." Thus it comes to pass that learning is universally appreciated, and that the office of teacher is amongst the very highest in the social scale. The teacher is called the second parent, and in after days is often referred to by the scholar in that familiar form, so that lineage seems to descend through the schoolmaster or schoolmistress as naturally as through father and mother.

No profession or calling is thought of in the second age as to be commenced then. The most that is done is in preparation. "The limbs cannot carry till the skeleton is completed," is a maxim of the Saluts applied to this term. "The brain must not toil until its workshop is constructed," is another maxim also applied to the same period of life. In this period marriage is never thought of; it were a proceeding altogether out of fashion. Families in Salutland springing from such union would stand out like mere dolls in the rest of the community, and would be called dollards, or dottrells, stunted in growth, and stinted in life. There are a few families of dottrells remaining who would give anything to change the name that is tacitly applied to them, and who prefer to die out unmarried rather than perpetuate the abnormality they unfortunately represent.

In the third age, the business of life commences, and through it and the fourth age is continued running often into the fifth. It is

part of the whole economy of the Saluts that they never dream either of killing themselves or injuring themselves by work on the one hand, or by retirement from work on the other. They reason in this wise: A human being is constructed to perform a certain amount of work. His heart is born to deliver a certain number of beats, say, in one hundred years of natural life, three billions six hundred and fifty millions of beats. He is constituted to develop in the various organs of his body, so many trillions of active cells, which make up his molecular organism, and which duly supplied with force derived from without, are capable of performing so much work as they live and die. More force of heart, more development of cells, more life in short, no man or woman can ever possess, than that with which they are primitively endowed, as far at all events, as is yet known, and all the free-will in the world cannot change this one fundamental fact. At the same time free-will can do this much, it can use its own as it likes. It can wear out its cell life altogether equally and sedately, and so live the whole allotted time keeping a good margin; or it can wear out its cell life altogether and rapidly, leaving no margin; or it can wear out the cell life of one particular organ, brain, heart, stomach, liver, kidney, by excessive use and exhaustion of the cells of such organ, and so can kill the whole organization, by the death of one organ, the rest of the organs being still in condition, perchance, for years of activity.

Such being the facts, they continue to argue, it is the best policy to let the life run out by the first plan, evenly and sedately. That plan ensures plenty of time for all a man can do. His ambition directed to worthy objects can be most entirely sated by this procedure. He can live to conceive great and useful thoughts and acts, and to bring them to maturity. He can live to recast those thoughts and acts, to compare them with the thoughts and deeds of other men, to leave them perfected and original in the strictest degree, and to hear and realize the faithful opinions of contemporaries young and old.

These slow steps towards honour and fame sanctify both honour and fame. They give to the good and the great a foretaste of what shall be said of them when they are dead, and they prevent the young and middle-aged from hoping and expecting to be over-

praised by contemporaries until the day of their work is drawing to a close and the work itself has been long enough before the world to permit of a judgment being passed upon it. He only can be wise who has ceased to covet the praises of men, is the idea and the practice in Salutland. He only should retire from active work from whom work retires, is another idea and practice so faithfully followed, that every town yields many workers who, like Titian the Great are doing their full quantity at the centenaries of their births.

By these methods life in Salutland is meted out into its appointed natural time, and as work is honoured universally, and idleness only is despised, there is never more work put on any man or woman or child born, than that man, woman, or child can bear, with the full assurance of length of days. For all necessary purposes,—such is the easy and equal distribution of labour, and so comparatively light are the tasks of labour,—from three to four hours in the twenty-four are sufficient for everything that needs to be done, by the busiest of the busy, to keep the social machine in perfect order.

Thus, in Salutland, ample time is left for the pursuit of every useful, healthy, and ennobling occupation. Its happy people copy in their public places a sentence they have taken from our own Akenside :—

> " The men whom Nature's work can please,
> With God himself hold converse : grow familiar
> Day by day with his conceptions, act upon his plans,
> And form to his the relish of their souls."

They cultivate every beautiful and refined art. They cultivate every branch of natural science. Those pebbles on the seashore of natural knowledge which the divine Newton left there with admiring gaze, they pick up, and, as best they can, investigate. Their literature, chiefly of Nature and of Life, and History of Life, while it has lost none of the brilliancy and point of the present rapid method, is deeper and richer and newer. The age of criticism has passed away. Any man can criticise, but who can originate ? That is what their readers want to know. To visit all the planets, make the grand tour of the earth ; to know all history by biography, so that no man or woman who has helped humanity a hair's-breadth on its way, may escape their appreciative and correct knowledge ; to

compare all artistic existence with the nature from which it sprang; to read men through the languages they have spoken; to study the physical directions of mental phenomena, and from the repetitions of history to forecast even history; these are the studies of their learned men, and the text from which the learned impart their stores of erudition.

To perfect these studies every means is offered by which without prize-giving or other false stimulus, the choicest rivalry may be naturally imported. City competes with city for the advancement of the useful and the beautiful, so that it is indeed something to win intellectual rank in any department of intellectual life. That music should hold a first place among the fine arts is only natural in a nation where every one is taught melody; and music is most perfected. The stage maintains its reputation, and is utilized to the grandest purposes. Stripped of its false trappings and cleansed of those faults which up to our time have caused it to be held in some kind of disrepute which should never be attached to it, it is here one of the noblest of professions. It is made a veritable school of history, in which the known past of the world is depicted with a fidelity that makes the old live again. But the maudling sentimentality of mere love-playing is treated with the contempt it deserves. Even the "Lady of Lyons," the staple play of our time, is voted intolerable; Claude Melnotte is looked upon as a useless prating imbecile, and the lady herself as a foolish child badly trained. When this play was once tried, the audience one by one quietly left the house, the mode by which the Salutlanders decidedly and gracefully testify their displeasure.

Art in the form of sculpture is encouraged with equal care, and the sculptor finds the most splendid scope for his labours in the embellishments of public buildings, and in the memorial tributes to the dead. In Salutland the process of disposal of the dead is duplicate in form. The dead may be placed in newly-constructed earth, in which re-solution is of the most rapid character; or they may be subjected to the all-destroying fire and reduced to ashes for the sepulchral urn. But though the body be destroyed, the remembrance of the dead is more faithfully retained than was ever done by the Egyptian embalmer or the Ethiopian artist, who enclosed his dead in crystal pillar. Here the sculptor comes into the field; and

in the splendid "temples of holy memories" that are attached to every town he erects some gem of art to every one, gentle and simple, who has worthily passed away in that place.

Architecture is another profession which vies in splendour; and the immortal mediæval architects themselves might look, with wonder, at what is to be seen. They would marvel most, perchance, when they beheld the new work which Sanitation has imposed on the architect, and which, with earnest sympathy and consummate skill, he has striven successfully to sustain.

And here, too, the true painter has found a home. The design first suggested by the author of the "Theory of the Fine Arts," an Englishman of the nineteenth century, Mr. George Harris, has been fully carried into practice. Each town in Salutland has its copy gallery of some of the old-world masters, the touch of the master of antiquity being here reflected in the touch of every new master, however brilliant his own genius, or assured his fame for original conception and grandeur of execution.

Science holds pre-eminent sway in Salutland. It is the unembodied Nestor of the teacher and the taught. To know is to exist, and science is knowing, existing. For the museums of science, the collection of the works of the Universal Father, the architect expends his best designing energies, the builder his finest work, the mechanist his choicest skill. Astronomy still heads the line of the pure sciences, chemistry follows, and meteorology, geology, natural history, anthropology, mechanics, and engineering, and other sciences find all their true places. Health science stands alone. It includes all the rest. *Salus salutis; scientia scientiæ.*

While thus, in systematized order, the gentle and refining arts and sciences are cultivated as exercises for the mind, the physical health is tended with equal care. Out-door life is the first thought, and out-door exercises of a skilful and useful character are to the fullest extent encouraged. All the young are taught to swim, to row, to ride, to skate, to walk with ease and stateliness, to climb, to play at invigorating games, to dance, to speak in public, and to become efficient in the gymnasium. The daily ablution in the bath, the daily exercises of muscle and limb, are made as distinctive necessities as the taking of meals; and, withal, the dress in which the body of both sexes is clothed, is made so loose and

obedient to every movement, that no deformity of body from dress is possible. One of our present fine ladies, with her waist like a wasp's, her heart pushed up to her throat, her lungs compressed into mushrooms, and her breast-bone making advances to her spine, would only be permitted in Salutland as a public exhibition of foreign deformity and barbaric folly, whom women would despise and men loathe.

All people who are truly healthy are truly courageous; for true courage rests entirely on a quick perception, a wise intellect, and a sound heart. But the Salutlanders, knowing that virtues require practice, and teaching that he who is afraid to die is afraid to live, encourage to the utmost every enterprise which calls forth bravery and presence of mind, provided that it be directed towards the advancement of natural knowledge, and the protection or saving of life. In the life-boat services, the women as well as the men take part. They do the same in travelling on land and in the regions of the air. In adventure, as experimentalists and explorers, none are more coolly daring than the men of Salutland, and though little is left to explore on the surface of the earth, for the North Pole has long since been visited, and Africa and Australia are altogether known, their expeditions have gone nearer than any other to the last impregnable spot, the South Pole; while they have almost originated the science of submarine travel on the floors of the great seas, a science which has yielded a grand field for new research and for the exhibition of the noblest qualities of courage and endurance.

My inclination is good enough to lead you still further amongst my model people, for though they exist not, I have seen them as distinctly as if they did exist, and I had been in their midst. They are a true and possible people, imaginary as they also are, and there is a great deal more to be related concerning them. I am driven by time to pass from narrative of them to the results of the health and life they are supposed to represent.

HEALTH IN SALUTLAND.

The Salutlanders have already been spoken of so far as beautiful in shape and feature, happy, and in the keenest enjoyment of life. One reason of their acquired health is that they have mastered the pestilential diseases. An epidemic from pollution of air, of water,

of food, is with them impossible. The hereditary tendencies to disease are either lost altogether, or are so nearly eradicated as to be practically removed. The diseases incident to poverty are stamped out by the removal of their cause. The diseases incident to intemperance and luxury are stamped out by the removal of their causes. The diseases incident to occupation are stamped out by the careful and easy expunging of everything that is injurious in occupations. The diseases incident to worry are stamped out by the abolition of maddening, exhausting, and useless strifes and ambitions.

In a word, this people contends only with the natural elements,—the heat of the sun, the flash of the lightning, the changes of atmosphere,—from the fatal effects of which they rarely suffer; and with the one destroying inevitable power, the gravitation of the earth which brings old age and death.

Thus, with the fewest accidental exceptions, the men and women attain the sacred age. Their death-rate is normal and constant, at eight in the thousand per year, and death itself, a painless final sleep, is hardly more than departure to rest when the day of work is done.

Let us now, as a practical study, glance at the simple means by which the results here described have been achieved. We may do this in the most practical way, and may learn by the exercise as much true sanitary knowledge as if the whole line of evidence were in actual demonstration before our intelligence. Any body of men and women setting forth, as I have supposed, could, as I wish to show, easily accomplish and verify my history.

This people, as I suppose them, originated from some three hundred emigrants, who, at the close of the nineteenth century, in a period of great agricultural depression and political strife, left England, their native land, for what was then called the "Light Continent." Reaching the southern border of that continent, and not finding the kind of government and home they expected, they set forth on their own account, crossed over acknowledged territories, and finding beyond them a tract of land hitherto unexplored, full of singular historical memories of a lost race, and truly no man's land, settled there, and founded their dominion. At first they were mainly a Saxon people; but as they progressed, adven-

turous men and women of Keltic and Jewish bloods soon joined them, introducing the happiest combination as yet known of mixed races fused into one people; races ever retaining their individualities, yet producing a stable and united community.

In a sanitary sense, the start was excellent. The men and women who founded the Commonwealth were from the best working blood of the country that gave them forth. If they had not had courage, endurance, fortitude, perseverance, physical strength, and, in one good word, stamina, they would never, in the bloom of life, have left their native shores. They were, moreover, freed from the bondage of intemperance and were thus delivered from a scourge, which in our own land of to-day directly and indirectly destroys the physical life of one hundred thousand a year, with forty per cent. of the destroyed mental life of the nation. Thus they were a splendid foundation for a long-lived people. Then they became mixed in race; and this again favoured the development of a future healthy community, admixture being, under favourable circumstances, a steady source of strength, without deterioration of racial qualities.

On the whole they might be taken as having at their start an expected life value of fifty-five years with an annual death-rate not exceeding fifteen or sixteen per thousand.

They were also extremely fortunate in respect to climate and land. The soil they occupied was so fertile, it yielded all their immediate wants, and as they spread out and enlarged their territory, under the administration of a limited homestead law, they were not induced to enclose themselves round particular centres in densely-packed dwellings. By choice they were soon chiefly engaged in agricultural pursuits, and although, by necessity, a minority of them became occupied in industrial arts, these also retained some character of the husbandman. If the factory or in-door worker or mechanic had not his fields to till, he cherished his garden, so that throughout Salutland the sentiment of Sir Walter Raleigh, that no man has a house who has not also a garden, was fully appreciated.

To these advantages the settlers in the new land added those of education. The thirty years' work of the English School-Board system had told marvellously on the intellectual development of the

people. Every settler could read well, write well, calculate well, understand the geography of the earth, and hold a sufficient knowledge of natural history and natural science to enable him to apply the gifts of Nature to his own peculiar requirements or necessities.

Priceless boon of all, these settlers had become indoctrinated in their own land with the elementary truths relating to public health. They had learned the lesson of physiology; they had acquired a certain knowledge of what were, and what were not, healthy places. Chadwick's estimate of an eight per thousand death-rate as a normal constant, had been proved to them as possible with such effect, that they had learned to look upon it as almost criminal for a civilized country to possess a town in which this rate was wilfully broken. They had learned the history of the diseases produced by uncleanliness, had become practised in the useful and innocuous distribution of sewage, and had seen the dangers that arise from pitching dwellings in damp localities, and from building dwellings of materials that absorb and hold water. In accord in spirit, with the best information on these points, they carried out the spirit to the letter in their practice, and so began on a new and sound foundation. Ignoring all thought of false economy, destroying by fire all carriers and sources of contagion, and providing for the instant isolation of every case of contagious or infectious disease, they stamped out the communicable diseases wholesale, with a success and readiness which were surprises even to the most sanguine preventionists, and which gained for them ten years of life.

Other lessons than these they had also learned in their old world. Three lessons in particular. They had recognized the great truth, that all sanitary teaching is as so much good seed flying wildly before the wind, to grow up among thorns and thistles, so long as women are not employed to collect it in the million little garners called home, and utilize it there. The men are not the workers in those garners, know little of them in detail; the women know them inside and out, and are the natural custodians of the health that fades or blooms there. To the women, therefore, they wisely confided the domestic health, and with that vital sympathy by which women excel over men, as day in its brightness exceeds night,

they made the labour of health a labour of love; whereupon the battle of long life was at once more than half gained. "The women conquered the grasping earth," exclaims one of their chroniclers, "and danced away with death whenever he approached their young, whom none nursed save the mothers who gave them birth."

A second great and special lesson, which this people learned from the faults of the old country, was the lesson of the golden mean 'twixt destitution and luxury. Cowper had sung to his countrymen, from Horatian wisdom:—

"He that can hold the golden mean,
And live contentedly between
The poor man and the great,
Ne'er feels the wants that pinch the poor,
Nor cares that haunt the rich man's door,
Embittering all his state."

But the countrymen of Cowper laughed only at him and his Roman philosopher, and as a result, were pinched on one side and haunted on the other, until death indeed, with equal foot, literally gambolled among rich and poor alike, poverty and luxury, hand in hand, his truest friends. Seeing this, our new people determined to live that they might live. Completely realizing the sublime truth, "the sting of death is sin," they trained themselves to let neither poverty nor luxury tempt them into sin. To this modest, yet saving rule, they educated their young, and they saved them thereby, in saving of passional or emotional trouble alone, some good ten years of that *vis in posse*, upon which the centre point of life turns. The canker of the heart; the *atra cura* of our age; the

"Bubble, bubble,
Toil and trouble"

with which the weird Fates of this day fill the cups of the foolish, were thus removed. "Once in trouble always in trouble," say the Salutlanders; by which they mean, that the man who has been bred in trouble never escapes its taint even though, in the end, fortune may shine on him. With these reforms they learned to abjure the use of tobacco and all other narcotics as luxuries, by which they added another fraction to the benefit of long life.

Once more, these new settlers began their life with an assurance of another grand truth, which was, that if they trained their

children so that manhood and womanhood should never be assumed until it had arrived; if they, with this method, let perfect chastity of life rest for its development on the absorption of the whole mind in pure and ennobling pursuits; and if they let marriage, and the domesticity that springs only from marriage, be the one binding connection of the sexes, the number of population would answer for itself according to ordained natural law. "The lawless alone are sterile, or over-populous," is their accepted rule. "Poverty," they say, "feeds the cradle and opens the grave: luxury casts the shroud even over the cradle. Thrift rocks the cradle, and presents its occupant loyally to the world ready to live the appointed time." In this way they proved what Dr. Farr predicted, that increase of years of life, while it makes decrease of annual mortality, does not necessarily cause any increase of population.

It would surprise no Sanitarian of this day to hear that a community living under the favourable conditions I have described, had reached to the attainment of splendid health and longevity. The lowest calculation of their life could safely be put down at a mean of three-score years and ten, with a prospective of fifteen years more for the life I have ventured to depict. This, however, were insufficient by thirty years of the true life value. It remained for certain other improvements to be made for the Salutlanders to reach the perfected existence. What these improvements were I proceed finally to tell.

The philosophical physicians who soon came to the front in Salutland were, as we have already seen, scientific sanitarians, as well as professed healers of the sick. Any man who called himself a physician was held of no repute unless he combined all these characters, and, on the ground that prevention is better than cure, let prevention stand first in his thoughts. If any one remained content to treat the sick and to be concerned merely with the symptoms of disease, and the medicines that would, as it was fancied, cure the sick, he quickly fell into the position of an empiric, and found it difficult to hold a place in the pale of the legitimate followers of Esculapius. "Give me the management of the food, the fire, and the window of the room of a sick man," said one of the legitimate representatives of this philosophy, "and though all the empirics of the Commonwealth with all their nostrums, be called to

treat that sick man, I will govern everything they do that is not actually mischievous." Thus the science of medicine, which in its true and honest position is always in the front rank of advancement, was now somewhat changed. The doctors continued to keep a correct history of diseases, of the course of diseases, and of the causes of diseases, but they added an equal knowledge of prevention, particular and general, and valued that knowledge most.

As in this way they became more and more imbued with philosophical principles, they instituted a grand inquiry, which was called by some the grand instauration of medicine. Dismissing all special modes of cure by particular systems or assumed specifics, they determined to know once and for ever what diseases would and what diseases would not get well without the aid of medicines of any kind, the general conditions for recovery being rendered as perfect as was possible. They agreed, in common, to test this method for a month ; this being found satisfactory, they extended the trial for three months, for a year, and finally for five years. They then compared the results of those years with the results of the same number of previous years. The revelation was astounding, and practically reduced the system of treating disease by drugs to such a minimum, that the drug trade ceased virtually to exist. The prescribers and sellers even of infinitesimals were themselves forced at last to give up their case, and to admit that their eyes had been made the fools of their other senses.

This discovery of the triumph of preventive art did not satisfy altogether. It left on record the fact that Nature never goes out of her path to cure, and that what has been called the *vis medicatrix naturæ*, was as much a myth as any other of the past myths of physic. It left on record, also, that under the happiest apparent external conditions some diseases will run their fatal course as decidedly without medicines, as with them.

The diseases which so progressed were, in turn, discovered to be diseases of what we call constitutional type, depending upon heredity. They were four in number : scrofula with its attendant, pulmonary consumption ; cancer ; specific disease ; and, insanity. The majority of the physicians, seeing the results I have named, began at once to teach that, as these diseases were obviously diseases of descent, and were maintained by the inter-marriages of persons

subject to them, there was only one sure and certain mode of removing them, and that was the common-sense rule that such intermarriages should not be tolerated. Gradually, as this true light dawned on the people, the advice was followed with the effect, in an incredibly short space of time, of eliminating these last and most potent miseries of mankind. A few of the physicians, more enthusiastic than the rest, continued to follow out means of cure, and so to set heredity itself at defiance. Whether they would have succeeded remains an open question, for they lost their chance of testing their learning. One of them, it would seem, did advance so far as to declare that he had discovered a true specific for the worst of the hereditary complaints; but when he was prepared to put his plan into practice, he failed to find, in his own country, the precise case on which to exercise his skill. His brethren thereupon, with much good feeling, provided him with the means to cross over to America to practise his method there. He went, and found abundant opportunities; but reaping, unfortuately, an unmitigated failure, he was soon content to come back to his own people, and to admit that prevention is the natural secret of medical success.

By the eradication of the hereditary diseases, the Salutlanders added full ten more years to the expected value of life, with a near prospective of the full hundred years before them, while insanity was reduced to half its former degree in one generation.

The second of the final advancements had relation to food and feeding. The physiologists, dealing with the two questions of digestion, and food for digestion, were led to the conclusion that a considerable shortening of life was induced by the excess of work which was put on the digestive organs. They bore in mind a fact I have already mentioned, that many persons die from the wearing out of one particular organ, the rest of the organs being still healthy. Of all organs, they agreed the stomach is most exposed to this danger. It is so much more worked in comparison with other organs, that it must be the first to die, unless the uses to which it is put be wisely directed. They found on inquiry, that the truth was as they suspected it to be, and that the stomach was distressed both by quantity and quality of food. The result of the research led to quite a social revolution. Following a suggestion thrown out by Flourens, they decided, on anatomical grounds, that

man was neither herbivorous nor carnivorous, but a frugivorous, or fruit-eating animal. Next they estimated the precise amount of food and of drink that was necessary to support the reserve and the active life in the varied stages of life. Again, they determined the reduction of food that is required when the reserve life is withdrawn, and when, the active life being left alone, it is the more requisite that no additional surplus of tissue or fluid, fat or water, should encumber the body, that no excess of force should be supplied to the digestive organs to the deprivation of other organs equally important, and that no over-taxation should be cast on the digestive organs themselves. Step by step, they were led hereupon to the introduction of an entire change of food and feeding. Animals were given up as sources of sustenance, fruits became greatly in demand; the bread-tree competed with wheat grain; the banana and the grape were called largely into use; the juices of fruits almost entirely superseded water as beverages, while chemistry, coming in always to the assistance of man, easily transmuted many vegetable substances into the most perfectly digestible of foods for every variety of age and constitution. Of purely animal substances, milk only, and the products of it, butter and cheese, retained full sway. Of the vegetable kingdom not frugivorous, cereals, pulses, tomatoes, potatoes, and other fresh vegetables, with the edible fungi, retained their usual place; and in respect to quantity of food and drink, not more than half by weight began to be consumed compared with what had been consumed before. The change thus commenced soon became universal. It modified not in the least the spirit of hospitality, while it refined it immeasurably. To banquet for the sake of mere sensual gratification became an obsolete vulgarity; to eat till the sense of oppression from food was the accepted index of enough, and nothing less, was soon considered worse than vulgar; while the value of abstention to the body at large, by the saving of digestive power and of stomach cell life, added another period to the general life that had already been acquired.

Still there was a certain failure of result until the last of the later advancements, the last in order of time, and the final in order of complete accomplishment of obedience to natural design, came into force.

The reform which thus perfected the economy of life had relation

to sleep and rest. It sprang from the virtue of necessity rather than from intelligent foresight.

In Salutland, the people originally were proud of the success they had attained in producing artificial light. They had excellent sources of power for working engines and batteries. The success led them to turn a great part of the night into day, to hold their grand assemblies late, and often to keep them open until beyond the small hours.

Everyone felt sure that this practice was quite unnatural, and the ministers of health were incessant in pointing out that it caused nervousness, irresolution, passion, bad sleep and irregular wearing out of the body through the nervous system. They insisted, too, that nature herself suggests a certain early hour for sleep, and that although we can by force of will reject the indication, we suffer for our obstinacy. They showed again that this remaining friction of late hours hindered the completion of the natural term of life, and they pointed to the lower animals to show how much wiser in this regard they were than men. It was of no avail; a bad habit fostered a bad resolution.

At last came a crisis. Rich as the resources of the country were, the supplies, from sheer extravagance and large export to more extravagant nations, began to fail. What was now to be done?

The important question was solved by a telling and, it may almost be said, amusing enterprize, carried out by one of their most esteemed philosophers, Professor Northstar, the grandson of the man of the same name, who took so active a part in the early settlement.

The Professor, finding that general argument did not prevail, announced one day that he had made in his laboratory,—a magnificent temple of science famed all through the world of science,—an extraordinary discovery in lighting. He had discovered a source of light which out-vied all competition in effect, and which was so cheap and obtainable that every previous invention paled before it. The statement was received with equal wonder and admiration, and when the Professor published that he was about to give a demonstration of the discovery, his lecture-hall was crowded by the most intellectual persons in the land. To the surprise of the people, considering his frequent previous teachings, he called

them to meet at midnight. His theatre was lighted with the most gorgeous dîsplay, and as he passed on in his discourse he literally entranced his listeners by the beauty of his varied demonstrations and the brilliancy of his expositions. Every known form of invented illumination was brought before them, and the expense incurred in each case was carefully presented. Expense seemed to rise on expense until the right time came. "And now," said the Professor, "I am going to show you the new discovery. It eclipses all you have seen in brightness, and it costs you nothing. Accept it for nothing, show your gratitude, and make the sun your fellow workman!" As he said this, on a given signal, the dense shutters of the vast theatre, silently and instantly fell, letting in the matchless light of the glorious newly risen sun, with a splendour that cast all the other lights into the shade. The audience, astounded, and actually for a moment not aware of the source of light that enshrouded them, all but exploded with acclamation when the truth, like the light, filled them. As their cheers rang out the Professor bowed his farewell, and next day the whole Commonwealth was full of the event. The papers wrote on the lesson, the people pondered, and being open to conviction they accepted the instruction. "Make the sun your fellow workman," became a proverb which passed from mouth to mouth, and mind to mind, until the thing was done.

When the sun became the fellow workman of the people of Salutland, the redemption of their bodies from premature death was carried out with the fullest success. The people saved millions in money, but this was nothing to the other saving. That nervous system of theirs, that system which takes in the outer universe, which is stirred by its waves, and sleeps, if it be permitted, when the waves sleep, found at last its natural time for work and for rest. All Salutland laid down, like one vast living world, to enter oblivion and to wake from it, filled with another spell of life, ready to greet another day.

The hundred years in Salutland were won.

Benjamin Ward Richardson, M.D., LL.D., F.R.S.,

President.

SECTION I.

SANITARY SCIENCE AND PREVENTIVE MEDICINE.

SECTION I.

The First Principles of Sanitary Work.

The President of the Section, Dr. Alfred Carpenter, delivered the following Address :—

The subject of my discourse is Sanitary Science and Preventive Medicine; although "as old as the hills," it is, as a science, of modern growth. In no other branch of science have we so few landmarks, and so few charts upon which the rocks and quicksands are fairly laid down. In no other science are there so few recognized dicta which can be accepted as axioms or dogmas, or acknowledged as postulates upon which a more elaborate fabric may be erected. This paucity of material does not arise from its absence, but because the axioms have to be agreed to and complied with by the masses before their truth can be ascertained. The results of the applications are too often marred or rendered nugatory by the independent action of a free people; whilst, if the axioms be applied to a people who are not free, there is a similar result; for it is impossible to obtain a compliance with Sanitary law in private among those who do not know the reason why such commands are issued, however much a despotic authority may be able to control and to direct public actions. Thus it happens that Sanitary Science must be the outcome of a clearer knowledge; and its perfection can only be brought about by a judicious instruction of the people in the fundamental principles upon which, as a science, it naturally depends.

The foundation of local self-government is based upon the knowledge of the majority of the electors; and it is certain that the elected will not (except in a few instances) proceed much in advance of the intelligence of those who elect them. I hail, therefore, the opening of a Congress such as this as a step in the right direction, because its object is to interest and instruct the people in those first principles of Sanitary work which will enable the electors to choose the good and refuse the evil, with more dis-

crimination, from among those who wish to take part in the noble art of local self-government; and by that means enable them to check the consummation of some of those gigantic jobs which are sometimes carried out in the name of Sanitary Science, but which are only started for the purpose of benefiting some private individual.

The first principles of Sanitary law are so often in antagonism to private interests, so often opposed to the pecuniary advantage of the few—who are also at times themselves the mainsprings of local authority—that it is not surprising to find unsparing efforts constantly made by interested individuals to show that the first principles are wrong. These efforts may be made in good faith, one or other of the fallacies of induction which Lord Bacon describes as "idols of the understanding," blinding the judgment, and causing the opponents of right principles to delude themselves into the belief that they are public benefactors, by reason of their antagonism to the proposed change. These and other kindred causes tend to keep the science of disease-prevention on the threshold of that domain which a more perfect knowledge will accord to it, and which is only to be obtained by a generous instruction of the people in those axioms which are already established as scientific facts, and which, as such, are bases for future work. This science is destined to alter the whole field of medical practice; to render obsolete much of our present knowledge as to the natural history of disease, and the measures which are now required for its treatment. The inquiry must come as to how the incidence of disease is to be prevented, rather than, having arisen, how it is to be cured. This will apply to every kind of complaint, and will not be limited to the zymotic class. Recent observations have shown that there is not much difference, except in degree, between tuberculosis and pyæmia; and that all the class of so-called strumous or scrofulous maladies, including consumption, are as capable of prevention as is ordinary blood-poisoning. The inquiry must be made, therefore, why phthisis appears so often in our death-lists, as well as scarlatina or typhoid fever. Nearly all the diseases which are fatal to young people are amenable to prophylactic measures, and capable of diminution in their fatal effects. If these deaths can be diminished—and of this there can be no reasonable doubt—it is probable that they may be altogether prevented by a right application of knowledge; and then pneumonia, bronchitis, mesenteric disease, and other causes of death among young people, will cease to be common among us, as well

as those deaths which are produced by enthetic disease. Many of those evils which affect bony tissue, and which now give occupation to the surgeon, will then become diseases of the past. Those ailments which disfigure the human form will then be found more often in fiction than in fact among civilized people. It is a glorious field, and opens out to our view magnificent prospects. The death of the child will be the exception, and not the common end of more than half the human beings which are brought into the world. It is a serious thought that the majority of the population of the kingdom are deprived of their natural birthright, viz., "health and life," by the ignorance of Sanitary law which now prevails. When a more perfect knowledge obtains, we shall not be able, as now, to say with Pope—

> "As man, perhaps, the moment of his breath,
> Receives the lurking principle of death ;
> The young disease, that must subdue at length,
> Grows with his growth and strengthens with his strength."

Disease in the young now strengthens with his strength, because we live in unnatural states, because we breathe impure air, drink foul water, use corrupt food, and disobey the laws of nature :

> "Where order in variety we see,
> And where, though all things differ, all agree."

There is no occasion for the idea expressed by Pope, that hereditary disease must run its fatal course. There is a power in the human frame to throw it off. That power is stronger in youth than the tendency to decay. It is seen in all families. Healthy children are born to unhealthy parents. There is a constant struggle in the human economy to recover its position, and remove from its tissues those matters which are unnecessary, and which are foreign to its requirements. The elements of disease are not parts of necessary tissue. If the efforts for their expulsion be made through channels which are capable of acting as exits for excreta, they will be successful, and the intruder will be expelled; but if they be made by organs whose daily perfection is necessary for the continuance of life or the performance of some endowment of the body, disease arises which may or may not end in health. If, then, we add to the troubles of the system more work for the diseased organ to do, health cannot be the outcome of the action. If we, by our social and moral customs, increase the quantity of morbid matter in the blood, we lessen the chance of health to the individual.

I have come to the conclusion that there is no truth in the theory which I once heard propounded by an eminent Sanitary authority: "That Sanitary Science was responsible for the propagation of a weakened race of beings, and was therefore tending to people the earth with a debilitated race of men." This is not the effect of Sanitary Science, but a consequence of a neglect of it. There is no occasion whatever for tissue or matter which is not required for the perfection of the human economy to be propagated for generation after generation, "growing with its growth, and strengthening with its strength," if the laws of nature be obeyed. The sequences of a disobedience to these laws are seen for three or four generations; but if the errors of the fathers be not followed by the children, there is sufficient power in the human frame to throw off the burthen, and to reclaim its birthright of good health. The gouty great-grandfather has the dyspeptic and rheumatic grandfather, the hysterical and neuralgic father, whose children throw out the mischief by some skin eruption or other evacuation; and the evil which the great-grandfather induced by his indulgence in the pleasures of the table, the bottle of port, and general laziness is lost sight of. Let his progeny do right, and obey God's laws, and, at the end of three or four generations, there will be a removal of the gouty diathesis or the tubercular constitution. An observation of several generations in numerous families is convincing me that this is a right deduction. It must be so, otherwise there could not be a single healthy person among our English people. If we follow backwards the connections of each one of us, in five generations there have been sixty-two stocks, and, in six generations, a hundred and twenty-four individuals, from each of which every person has had the chance of inheriting disease, if inheritance were a progressive law. The chance of escape would be infinitesimal, and no healthy person could be found among us at all. True, it is a common thing for diseased children to be born of diseased parents, and for these children to die of that inherited disease in their infancy. It is uncommon, even if it ever occur except from accident, for the offspring of healthy people to be diseased at their birth; whilst delicate fathers and mothers very often produce sturdy children, who grow up without a particle of disease about them.

However much, therefore, it may take the fancy of those opposed to Sanitary work to support the idea that it would be better for the human race if insanitary conditions were allowed to hold sway among us, there is no real truth in the statement. It is contrary to

our experience in nature for such a clumsy contrivance to exist, by means of which the human family would long ere this have been like the extinct monsters of former ages. We may banish the idea, then, that Sanitary work promotes the growth of a diseased race and tends to weaken the whole human family. The natural tendency of disease is either for it to destroy the blighted being, or for the diseased material to be expelled from the body. If a few generations could be brought to obey the laws which common sense and Sanitary Science have already pointed out as necessary to be observed, hereditary disease might become a thing of the past, as much as some of those maladies which used to be common among us, but are now altogether lost sight of. But hereditary tendencies are of great importance at the present time, and must be carefully studied by the student in preventive medicine. If we consult any treatise upon medical practice published in the early part of the century, we find that the most learned physicians of those days taught that diseases had various names which distinguished them from others, and which were mainly derived from the particular organ affected. Thus inflammation of the lung was described as a disease completely separated from inflammations of other organs. It was regarded as an entity in itself, which must be discovered early and treated *secundum artem.* Pneumonia was pneumonia, and nothing more. Now, however, physicians who are not routinists have discovered that pneumonia is more often the local manifestation of a general malady than a disease limited to a particular locality. The physician now tries to find out whether the disease has a zymotic or malarious origin, in which case he knows that it is only the point at which the fever is more active in its effect than at other parts of the body. If not zymotic, it may be gouty in its character. He has then to inquire whether that gout has been inherited, or has been obtained by the manner in which the patient has been accustomed to live. Or he may find that it is tubercular in its origin, or due to infection from pyæmia or septicæmia. It may be syphilitic in its character, or be due to a malignant diathesis. These particular observations are of much more importance than the mere fact of there being local disease. They are tending to reduce to very moderate dimensions the classes of disease which affect the human frame. The registration of deaths in its present form is of no scientific value; and, except the inference which may be drawn from the total number of deaths as compared with those which are produced by zymotic causes, is useless for scientific purposes. It will be observed that deaths registered as caused by pneumonia

may have had an origin in some constitutional condition of the system, which, if it were tabulated, might give valuable information. The table as at present constituted places deaths, which have had a similar origin, in every part of the list. I would suggest, as a necessary alteration of the law regarding registration of deaths, that the certificate which details the cause should be transmitted direct to the registrar; that it should be a confidential document, the nature of which the registrar should be prohibited from disclosing; and that it should be the property of the State alone. I make this suggestion because a large portion of the deaths which now arise are due to causes which are not, and cannot be, registered. I especially refer to those which have had a syphilitic origin, or which have been caused by continuous indulgence in intoxicating drinks. A very large portion of the diseases which affect particular organs, and in which the first starting-point is a kind of fatty degeneration of tissue, have their origin in the habitual use of intoxicating liquors. Head, heart, liver, kidney, lung, are all subject to this change, and the consequences are diffused over the whole list. The Registrar-General's returns, as at present constituted, give but little real insight into the habits of the people.

It is necessary for every family to have some knowledge of their hereditary tendencies, before they can take the best measures for the removal of such tendencies from their own persons. The prevailing diatheses and the hybrids which arise from inter-marriage must be recognized and treated accordingly, if good health is to be obtained. Treatment must not be limited to those times at which there is a local manifestation of disease. Prophylactic measures are necessary in apparent health, as well as during actual illness. It is a mistake to suppose that the date at which a given illness has apparently commenced is that at which it really began. In the case of pneumonia, for instance, it may simply announce the moment at which the mischief has reached the boiling point; it may be the evidence of an attempt on the part of nature to rebel at the treatment to which the body has been subjected, rather than to the actual commencement of ill-health. It is an effort of the system to throw off morbid matter and to commence its active removal. A dwelling-house is not a comfortable place to live in whilst repair and redecoration are being carried out. The necessity for repair and re-decoration commenced some time before the workmen were actively set to work. It is not less so with the human frame. Illnesses are the means which nature sets up to throw out morbid or used-up material. It is generally the patient's fault,

either from ignorance or wilful disobedience to law, if an organ become damaged in the operation. I wish particularly to dwell upon inherited tendencies, because it is often said that they belong to the inevitable, and families subject to them have to submit. This is not so; they can be removed. There is no reason why delicate persons should bring up delicate children, provided they are brought up in obedience to the laws of health; but, if they be coddled because they are said to be delicate, if they be removed from all those influences which make people strong and healthy, especially if they be made to take intoxicating drinks as a matter of course, they will be like a naturally hardy shrub which has been kept in a hothouse and not allowed to experience the changes from heat to cold, or to feel those winds and storms which rivet it more strongly to the soil. If afterwards it be planted in the open, it dwindles or remains a poor little shrub, liable to be acted on by blight, and is easily broken down by a moderate tempest or destroyed by a cold night. So it is with human beings if they be not in due time exposed to the changes which arise from heat and cold, to drought and moisture, to exercise and proper changes of food, and kept from stimulants. It is impossible for them to reach a healthy and vigorous manhood, or to go to the grave without the infliction of organic disease.

It is all-important for individuals to be aware of the tendencies which they may have inherited. He who has a gouty constitution or a tendency to fatty degeneration from indulging in excess of certain matters, may live quite differently from one who has a tubercular diathesis; whilst the man who is more easily affected by malarious disease should avoid conditions which scarcely affect the former at all.

The time has not yet arrived at which it will be possible to speak with much advantage in a public assembly regarding general diseases. Our work, as far as this Congress is concerned, is to deal with those causes which produce malarious or zymotic disease, and lessen the general health of the people. The incidence of the malarious class does fall more heavily upon some families than upon others; and some suffer much more fatally than others, as if they were pre-disposed to become its victims. At present, we have no certain knowledge as to the reason for this. The class itself is quite capable of prevention. The causes which lead to it are produced by circumstances which are absolutely removable, either by the State or individual action. I have been accustomed to treat

this part of my subject in the light of an algebraic equation, in which I assume that enthetic or zymotic disease is made up of members represented by x y x, the problem being to find the value attached to each member of the formula x y z. By enthetic or zymotic disease I mean any of those diseases which belong to the zymotic or infectious classes, and which are dependent for their increase upon matter which has been in contact some time or other with another and a similar case. I will explain the value which I apply to each member in the formula. x represents the human body as it should be in health. Each function or endowment of the body as performed leads to the production of some used-up material. This is represented by y; it always exists more or less in the blood, or is stored up as formed material, and cannot be used again for the same purpose. It is always in course of removal by the excretory organs of the body. It should be kept down to a normal standard, otherwise the natural balance is destroyed, and something goes wrong. z is matter from without. It is upon y that z increases and multiplies. If the quantity of y be normal, there is nothing for z to grow upon, for it will not flourish in the blood and juices of a healthy person. If, therefore, every function of the body be properly performed, if every endowment be naturally used, the introduction of z is comparatively harmless. It is only upon excreta or used-up matter, either in or out of the body, that z can grow. If y in any shape be abundant in the blood, and not removed as fast as it is formed, z increases and multiplies in that blood, and induces changes in it which may be incompatible with life. If there be little pabulum, the case is a mild one; and, if that pabulum be of very slow growth, it may be a long period before the patient can be liable to a similar attack again, and it may induce such conditions as may render a recurrence an impossibility. Two members of the formula x y z, cannot produce a case of disease. The whole three must be present. x and y alone cannot produce it, neither can x and z if y be kept at a natural standard; for, if z happen to be introduced into the body, there is nothing for it to grow upon, and it aborts. We cannot keep out y altogether, for it is formed in the very act of living. It is a sequence of life. If, therefore any special endowment of the body be not sufficiently exercised, or any function not properly performed, there is an alteration of the balance, and pabulum is provided, of a debased character, for morbid matter to run riot in. Thus it is that diseases of the enthetic class are epidemic at some times, and not at others, and among some people, and not among others, fatal effects more

certainly following in those whose blood or other juices contain particular forms of impurity.

Each type of disease requires a different kind of pabulum for its production, just as wheat grows better in some soils than in others, whilst there are soils in which it will not grow at all, but where water-grasses flourish. So we have scarlatina abounding among one set of people, typhoid fever among another, and dysentery among a third. There is nothing more curious or out of the way in the rise and fall of epidemics than there is in the abundance or scarcity of certain forms of vegetable life, according as the season is dry or moist, or hot or cold, and according as the material required for its nourishment is abundant or the contrary. At any rate, *z* is required for the production of a case. You ask as to its nature. *z* belongs to the vegetable kingdom; it may be very close to that part of the organic world which Dr. Allman recently described at Sheffield as the starting-point for both vegetable and animal. On the nomination of Mohl, he has styled it protoplasm. Mr. Huxley calls it "the physical basis of life." Dr. Allman says it is a liquid. I join issue with him upon this point; it is not liquid, it is not volatile, but it is particulate; and, although he calls it liquid, his own admissions imply a belief in its particulate character. Those granules to which he alluded so forcibly in his address at Sheffield are solids, however much liquid they may have attached to their constituent substances. They are totally destitute of structure, as far as our finite appliances can make out, but they are possessed of contractility, and are endowed with some vital principles quite beyond our microscopical powers to discover. It is not possible for any one to say that they are really structureless, because we cannot see their parts. They are differentiated in their functions and in their powers, and must therefore be differentiated in their matter, which could be seen if our powers were equal to their minuteness. To assume that our knowledge is final; to conclude that they must be structureless, because we cannot see their structure by our present microscopical aid, is as unsound as for anyone to declare his disbelief in the planet Neptune because he cannot see it with his naked eye. It is one of the weak parts of Dr. Allman's address in which he concludes that we have reached the limits of our powers, and that protoplasm must therefore be structureless. I consider *z* to be a particle of protoplasm altered in its functional power, so that it is capable of development only when it comes into contact with used-up matters which are the proper excreta of humanity; and just as the germ of the common mush-

room cannot germinate unless in contact with the excreta of some of our domestic animals, so the germs of enthetic disease fail to multiply if used-up matter in its proper form be not provided for it. $x\ y\ z =$ a case of enthetic disease; the problem is how to prevent its extension. z is thrown off in abundance from every case. It increases and multiplies out of the body as well as in it. It is an organic living particle which can flourish and propagate its kind, if pabulum be provided for it, but which cannot do so if the requisite matter be absent. The great work which the sanitarian has to perform is so to dispose of excreta that the human body shall not return within its own economy the used-up matter upon which it has fed, and which has resulted from the performance of its proper endowments, nor yet keep within reach any of the same materials by means of which z may be allowed to multiply, and at some future time be introduced into the system of another person, and so re-produce the disease. z is neither liquid nor volatile, but is a solid particle, which in some forms can be seen and weighed, and is as much a living particle as the germ upon which the dry rot in wood or potatoe-blight depends. Its position in the organic world is now definitely established to be vegetable; and, reasoning from analogy, there are some facts which are proved regarding some members of the family which it is fair to assume as applying to all. I am not going into the moot point of germ-theory as opposed to glandular theory regarding the production of disease. It may be that the truth lies between the two, and that the fatal result arises from the secretion of the vegetable germ, rather than from the speck of albuminous matter of which it consists. It may be that these growths produce a poison similar to snake-poison or woorara in its effects, and which kills by its action upon the nerve-cells of the body. It may also be that the eruption of scarlatina or measles may be caused by an acid produced by the micrococcus upon which the disease depends, allied to formic acid in its chemical characters, but which is so evanescent in its nature that the chemist cannot catch it any more than he can catch the poison which kills in a case of cholera. These are at present speculations; but they are lines upon which it is probable that future discoveries may be made.

There are four distinct and specific forms of infectious fever in which it has been proved that, coincident with the disease and accompanying it through its stages, there are forms of vegetation in the juices and tissues of the body which decidedly differ from normal states, and which are always associated with the disease in question. The pathology of these infective processes has been

thoroughly worked out by Dr. Burdon Sanderson; he has, guided by the work of eminent Continental pathologists, himself verified the facts, and they come before us with great authority. It seems to be fairly proved that small-pox, sheep-pox, splenic fever, and relapsing fever are propagated by vegetable organisms. They were made out by Dr. Keber of Dantzic in 1868; and Dr. Sanderson tells us that Professor Cohn of Breslau has also made out that the organisms which are present in vaccine lymph are also found in the lymph of variola, so entirely similar as regards form and development that it is impossible to draw any distinction between them. Professor Cohn gives a graphic description of these appearances, which is published in Mr. Simon's report to the Privy Council on Scientific Investigations for the year 1874. The same paper contains an account of the investigations of Dr. Weigert of Breslau as to the existence of micrococci in the lymphatics of the skin in persons who had died of small-pox. Dr. Sanderson says (page 32): "That organisms of a particular form existing in the lymph of small-pox, taken in connection with the occurrence of similar organisms in the channels of absorption leading from the pustules, suggest the probability of these having to do with the morbid process, but cannot be accepted as proof that they possess the property of propagating the disease. For the establishment of such proof, it would have to be shown either that, when deprived of its organisms, though otherwise unaltered, it is deprived of its activity; or that, when the organisms are introduced alone, they manifest the contagious property of the liquid or tissue from which they are derived." It has been shown that many contagious liquids lose their activity when they are deprived of their suspended particles. This has been shown over and over again in the case of vaccinia; but the *per contra* must be regarded as impossible, because the bodies themselves are so minute that there is not the slightest prospect of any one being able to separate them from the containing liquid in anything like a state of freedom.

There are methods of investigation which approach very clearly to the required conditions, and which enable us to assume with some degree of certainty that the organisms, if not themselves the cause of the disease, are always the vehicle by means of which the cause is carted about the country. We cannot investigate the pathological condition under which small-pox is produced in those stages in which it is most important to gain information, but comparative anatomy enables us to bridge over the chasm. Sheep are subject to a disease which is the exact counterpart of small-pox.

It is precisely similar in its origin, its progress, and its manifestations. Dr. B. Sanderson tells us that the virus contains organisms similar to those of small-pox and vaccine. The result of the investigations which were carried out by Dr. Klein can leave no doubt in the mind of any reasonable man as to the connection between the vegetations and the disease. He describes them as necklace-like filaments, of jointed structure; in some they are granular, which, under the highest possible microscopical powers, are seen to be highly refractive spheroids; in others, the filaments were so dense as to present the aspect of a felt-like mass, such as is seen in similar growths. He concludes that the highly refractive spheroids are the forms which are characteristic of the lymph in sheep-pox in its active condition. He was able to trace separate conidia in a state of germination, and, by their life-history, to connect them with vegetable matter.

There is another disease to which animals are subject, called splenic fever, or Milzbrand. It is sometimes called splenic apoplexy. It occurs in the horse, as well as in the ox, and was the first disease with which a specific organism in the blood was clearly associated. The peculiar staff-shaped bodies which are always contained in the liquor sanguinis in this disease were first made out in 1855. The most striking feature of the disease is its rapid progress; it runs its course in a few hours. In the horse, it is often called acute splenic tumour; it is accompanied by carbuncular infiltrations of the mucous membrane lining the alimentary canal. The carbuncles are not so often met with among cattle as they are in horses. The discovery of the rod-like bodies which always accompany the disease was made by Pollender. A year or two afterwards, Dr. Brauell confirmed Pollender's discovery (Virchow's "Archiv"); he considered them to be diagnostic of the disease. Other physiologists have corroborated these observations, and have shown that the rod-like bodies are from $\frac{1}{3500}$ to $\frac{1}{2000}$ of an inch in length, the width scarcely admitting of measurement. Although the evidence was much doubted at first, it is now agreed by all physiologists who have inquired into it that the rods are living organic bodies, and can communicate the disease to apparently healthy animals. The activity of the rods is dependent upon their vital functions; and, whether the rod is the absolute cause of the disease or not, it is always present, and the disease cannot be propagated without it. A curious fact has been established regarding it. The rods do not pass through the membrane which separates the mother from her offspring; and, when pregnant animals are affected by splenic fever,

the blood of the embryo is not contagious, and does not contain the staff-shaped bodies.

There are two other points which have been also proved regarding splenic fever. The contagious property as it exists in the circulation is only temporary. Dr. Brauell tells us, through Dr. Sanderson, that the moment the blood shows signs of putrefaction, it loses its infective power. The motionless rods give place to actively moving bacteria, which are not capable of spreading the disease. This point is an important one with regard to the incidence of other and similar diseases. It has been shown, also, that the actively-moving bacteria are not the progeny of the splenic rods, but appear rather to have eaten them up, and to have acted upon the dangerous organisms much as the infusorian animalcules and entomostracan crustaceans do in impure water, viz., remove the *materies morbi* from the liquid, and are friends and not enemies. But the contagium has also a stage of existence in which it is highly resistant. Bollinger tells us of ten cases which occurred in one stable near Zürich, between August 1868 and February 1872; there were no other cases in the neighbourhood; other horses and cattle surrounded the stable. The contagious agent must have been latent in that stable during the period in question. Each case appeared to arise independently of the preceding one, and indicated a form of contagion quite different from the staff-shaped bodies which disappear so soon from an acute case of the disease.

Some of you may ask the question as to what splenic fever in the horse has to do with the prevention of disease among human beings. I say much, because these same rod-shaped bodies have been discovered in the blood of human beings who have died of fever. There is a disease not unfrequent upon the Continent, which is termed by Buhl of Munich "mycosis intestinalis;" intense infiltrations occur in the mucous membrane with extravasations of blood. It was known in some of the cases that there had been communication with animals similarly affected. The tissues of the infiltrated parts were infested with the staff-shaped rods. These discoveries give us a clue to the causes of those infiltrations which arise in the course of other fevers. The rods are not there, but there are myriads of microzymes which have superseded some forms of life which corresponded with the rods. They may also explain to us the causes of those congestions which frequently arise in the ordinary fevers of this country, and which are followed by hemorrhages, abscesses, and enlargement of glands. The congestions may be caused by a mycosis, which is a colony of vegetable

organisms, but they become changed in their character before it is possible for them to be examined by the microscopist. "It may be that the presence of these bodies is as much a part of the process as the emigration of the colourless corpuscles from the blood-vessels is a part of ordinary suppuration."

The fourth form of disease which has been clearly associated with living organisms is relapsing fever. It was first proved in Berlin by Dr. Obermeier, who unfortunately died of cholera whilst making his investigation, and probably lost his life by his devotion to science. The presence of the organisms in the blood, and their association with the fever, were clearly made out. They disappeared as the fever subsided, reappearing when a relapse took place. The morphological and botanical characters of the organisms were subsequently determined by Professor Cohn, and a place found for them in the vegetable kingdom. They are proved to be spirilla, belonging to the group spiro-bacteria of the natural order *Schizosporeæ.* This genus he has placed in the family of Oscillatoriaceæ, of the class *Algæ*, or seaweed. By means of this classification, we are able to see daylight, as regards these forms of disease. Another eminent botanist, Dr. von Naegeli, has classified micrococci under the name of *schizomycetes*, and connected them with the great family of fungi. There is much to favour this notion; but the aerial nature of the fructification of fungi, as opposed to the aqueous forms under which the algæ flourish, leads me to conclude that the micrococci are algæ rather than fungi, especially in those forms of disease which are propagated by the agency of water.

The spirillæ of relapsing fever are always present during the hot stage. They cease to be visible after the temperature has fallen. They can be kept alive for a short time out of the body, and there is evidence enough to show that they can propagate the disease. The contagiousness of the fever, the tendency to recur which its name indicates, and the coincidence of living organisms pathognomonic of the disease, are clearly established. The number of the organisms increases with the increase of temperature, and seems to point out that the rise has something to do with the vegetable growth, somewhat after the course which follows during the germination of ordinary seeds. The rapidity with which the multiplication goes on in a congenial soil; the fight which takes place between the natural order of things and the unnatural; the effort to throw out the foreign material, all have their significance and find their analogy in all the class of enthetic diseases, from plague and cholera at one end of the list, to a simple ague fit at the other.

Besides the four diseases I have mentioned, some observations have been made regarding the communicability of diphtheria. Cryptococci, or cacozymes, as I prefer to call them (to distinguish them from the microzymes which are derived from healthy protoplasm), are found in the diseased tissue, and are said to spread the complaint. Diphtheria has been propagated by taking diphtheritic exudation from a case, and inoculating animals with it; a similar disease has then been set up. Similar processes could not be induced in the family organism simply by putrescent or decomposing material. Dr. Sanderson does not consider that this has been satisfactorily proved, but others have thought the evidence fairly sufficient. It would be inexpedient, even if it were possible, to prove it conclusively. To inoculate a human being with matter from a diseased animal is an experiment which is not likely to be made, but the facts deposed to by Dr. Oertel of Munich have their significance.

The certainty with which glanders can be propagated from animals to human beings is well known, as also in the case of malignant pustule or "charbon." The alliance of the latter disease with carbuncle, and the connection which may be traced between it and diffuse cellular inflammation, erysipelas, and hospital gangrene, are also well known facts. Thus we have connecting links with numerous diseases which are infectious, and which are propagated by morbid matter from man to animal and from animal to man. But the operation is not limited to its effects upon animal life. Rust, smut, and their allies among fungi, bring occasional ruin upon agriculture. The *Peronospora infestans* is likely to remove the potato from our list of common foods. Another form of the same family, the *Botrytis bassiana*, is the terror of the silkworm grower. The salmon fisheries have been seriously damaged by the ravages of living vegetable organisms; whilst, at this present time, the vine grower is in intense alarm on account of the ravages of *Phylloxera vastatrix.* The aspect of the vegetable kingdom is sometimes changed by parasites. The potato blight has an ordinary fructification, which is aerial, and can only be produced under special circumstances. There must be an excess of carbonic acid in the atmosphere, something not very considerably above the four hundred parts in a million which naturally belong to it. There must also be an excess of moisture and an absence of sunlight. These adjuncts are required for the rapid production of the ordinary fructification of the peronospora. If a bright sun and a drying wind arise at the proper time, the loss of a particular crop may be

averted. The ordinary fructification, and even the mycelium or root-matter, are evanescent; but it is not so with another form of fruit, which is found among the *débris* of the damaged crop, and sometimes in the rotting tuber. The resting spore continues to live; it is enclosed in a material capable of resisting the action of heat and cold, of sunshine and of rain, and has even germinated after being in boiling water for a short time. These spores probably exist in the soil, ready to spring up into activity whenever the necessary meteorological conditions arise, and continue long enough to allow of their germination. The genus Peronospora has a wide distribution, and it affects a large portion of the vegetable kingdom. How far it is possible from the protoplasm from which it springs, to change its character—say, from bassiana to infestans, according as it attaches itself to the caterpillar or the potato-haulm—is one of those problems which some physiologists say to be contrary to nature, but which I consider to be within the range of probability. One thing is certain, that the same parasite can equally affect both classes of organic nature. It is thought by some that fungi only attach themselves to, and can only subsist upon, those plants which are only weakened by some causes. This would only be following the rule which I believe to apply to human beings; but then the parasites themselves, by their irritating secretions, are able to induce a condition which allows them more play, and by producing debility enables them to take possession of their victim with greater rapidity. There is a second problem which requires solving; it is of great importance, viz., how far vegetable tissues which are diseased by fungous growth are capable of affecting the animals which feed upon them; and again, how far animals which have become affected with disease are able to spread that or some other form of disease, not only among their own species, but to other animals and to man himself, if he feed upon their diseased flesh.

I have mentioned the experiments which indicate the possibility of diphtheria being propagated from man to animals. Glanders can arise in both classes. Vaccinia is a disease common to both. There seems to be no difference between small-pox and sheep-pox. The transmission of trichina from animal to man is undoubted, and the communication of tapeworm is not uncommon. Cases of malignant pustule are obtained by infection from animal to man. There are several other diseases which arise either from contact, or as a sequence to the consumption of diseased meat or bread; and gangrene is not an uncommon result of the consumption of spurred

rye in those districts upon the Continent in which rye-bread is used. The secale or spur of ergot is a mass of fungous growth belonging to the class *Claviceps*, a genus of ascomycetous fungi. Its consumption is followed by a condition of the tissues which produces gangrene. There are some curious facts connected with the fructification of this plant; there is the production of a multitude of spermatia and so-called stylospores, which have active movement in air; they are motionless in water, but they soon germinate and emit filaments, and are ready for action in congenial soil.

We cannot look upon the diseases of organic nature with perfect complacency; we must not consider that they only affect our pockets, and not our health. Before English people can have that perfect health which is the birthright of every child born into the world, it will be necessary to alter our plans regarding the breeding of cattle, and the methods of housing and feeding them. Our domestic animals fall an easy prey to every kind of epidemic. For all Sanitary law is, as a rule, ignored by the farmer. Knowing something of the customs of the country, I was not surprised when I heard an inspector from the Metropolitan Meat Market declare upon oath, in Croydon Police Court, that 80 per cent. of the meat which was sent to the London market was the subject of tubercular disease, and that, to exclude it from the market, would leave London without a meat supply. The foul air in which animals are often kept, the foul water with which they are supplied, and the musty food which is given to them to eat, easily accounts for the readiness with which they fall victims to every kind of malady. The deaths among cows during the calving process is very great, and is one of the reasons why meat continues dear. Such deaths ought not to occur at all. We cannot remove disease from our midst, or reduce our death-rate much below 17 in the 1000, until we can ensure a more healthy progeny among our domestic animals. To do this, something more is necessary than to insist upon measures for the prevention of disease among men.

I have mentioned the position that organisms producing relapsing fever occupy in the vegetable kingdom. The spirilla belongs to the class *Algæ*. Professor Cohn has placed in the same class all the germs which give rise to epidemic diseases among men. It has been proved that bacteria are not the actual producers of these diseases; Cohn places them, however, in the same list, under the name of *microbacteria*, in a class by themselves. The micrococcus is grouped under the name of *sphærobacteria*, and divided into three

classes, viz.: 1. Those which give rise to colour like to that which causes "red snow;" 2. Those which cause a certain class of ferments; and 3. Those which produce pathological changes in the blood. I should alter this classification into micrococci and cacozymes—the harmless and the hurtful forms. I must, however, refer you to the list for the complete classification.

The peculiarities of fructification which belong to the Oscillatoriaceæ in which we have an evanescent and also a persistent form of germ, and with the evanescent an extraordinary power of motion, by means of which they are enabled to insinuate themselves deeply into living tissues (especially if those tissues are not normally healthy), is one of the wonders of their mission. Having found entrance within the portals of a living thing, they assert their individuality, and soon produce a new crop of similar material, provided there is pabulum suited to their requirements. This pabulum appears to be used-up matter of different kinds. It may be that different forms of disease are produced from similar germs, according to the position the germ attains to, or the food it has to assimilate; just as the head of the tænia becomes by transposition a hydatid cyst in the human liver, or gives rise to the staggers when it affects the brain of the sheep. It may be also that there are forms of vegetation induced by transplantation which can only be produced in that way; just as the common mushroom spore cannot germinate unless it has come into contact with the excreta of some domestic animals, so it may be possible that some of our diseases can only arise by the introduction of a proper germ at a time when it can come into contact with some other agent which is as yet unsuspected of having anything to do with the process. The large class of gregarina which exist as parasites within the bodies of animals from the highest to the lowest forms, having vibratile cilliæ and capable of much active movement, multiplying with extreme rapidity, have functions which are not yet determined. It may be that these parasites are powers in the equation $x\ y\ z$=enthetic disease; some of them or their allies may be necessary to enable the particle z to increase and multiply, and may account for their fertility in one person who has been infected, whilst another escapes.

This is not a far-fetched and chimerical idea, for Professor Dodel Port of Zürich points out that the fructification of the *polysiphonia subulata* (one of the red sea-weeds of our coasts) is completed through the agency of the beautiful little vorticella. A ciliated infusorium occupies the same position in the process that the bee occupies in the fructification of the willow catkin. But these are

points which botany has not yet determined, and I must leave a very enticing subject for more important and more practical work.

I will now go on to what I call the canons of Sanitary work. The basis upon which preventive medicine stands as a science is that of the *particulate nature of contagia.* It is the first canon law. We know that zymotic disease will not arise if the particle *z* is kept out of the process. Again, *z* cannot increase and multiply unless the material which has been used up in supporting the functions of the higher forms of life be also present. There are, therefore, two manifest duties for the Sanitary authority to perform: First, to remove the pabulum *y*, upon which *z* is able to increase and multiply, from its neighbourhood to man; and also, so to alter its character that it is no longer able to nourish *z* if the particle should be imported; second, to prevent the importation of *z*, or if it be in our midst, so to alter its nature that it cannot fructify. These duties can be performed if the laws which regulate the introduction and the growth of *z* are well understood and counteracting agents regularly employed. There are two forms of germ, the evanescent and the persistent. Measures which may be successful against the former and may limit the spread of a present epidemic, will not necessarily prevent its recurrence in the future at the same place unless both kinds of germ are considered.

There are several ways by means of which the natural order *schizosporeœ* may make itself felt, viz., by the air, the water, the earth, or the food. The contamination of the air in the neighbourhood of our dwelling-houses both above and below the level of the ground must be counteracted. This contamination is effected in two ways: 1. By the ordinary processes of decay which are always going on in organic nature; and 2, By the aggregation of living creatures. Both give rise to excess of carbonic dioxide; without the latter, it is probable that fungi could not flourish, but it is animated nature which introduces myriads of the germs of debased protoplasm which is food for *z* to flourish in.

The higher the animal life is in the scale of creation, the more injurious is the excreta of such animals, and that of man most of all.

The remedy for these evils is *ventilation;* anything which impedes it is contrary to Sanitary law. *Motion* is the second most important fact, and is the second *law* of Sanitary work. Currents of air must be established to lessen the quantity of carbonic dioxide to something less than four hundred and fifty parts in a million; and by introducing a fresh supply of oxygen, the albuminoid matters which

living creatures give out may be altered in their chemical characters, and by that means they will no longer give renewed life to *z*. Motion of both air and water is a principal law of Sanitary work. Air in motion is soon deprived of those organic matters which allow the growth of *z*, and the latter, as well as the food upon which it feeds, being very evanescent in its character, are soon changed into innocuous and even into useful matter. This was very forcibly impressed upon my notice in the year 1854, when I ventilated the soil-pipe of my own house by extending it upwards between the sewer and the trap; my successor in that house took away the soil-pipe, and in a few weeks a death from typhoid fever occurred in that house. Stagnant-air in the house-drains of this town produced more or less evil in almost every house in the place, until our local senators were convinced of the evil. It was in Croydon that the law for ventilating sewers was first put into operation by a local authority. But the local authority were then in advance of the intelligence of the people; and, although the command was issued, the work was not generally done until much more proof of its necessity was afforded. Now, the ventilation of the sewer and of the house-drain is required by the law of the land, but it is not nearly so general as it should be. Those openings into sewers were at first called stink-pipes, and were sometimes taken away because they gave evidence that the law of motion was not complied with. The foul smell which came out, showed that the sewer was a sewer of deposit, that it contained stagnant sewage; and the neighbour, like the ostrich of the desert, who when danger threatens hides its head, takes away the safety-valve and tries to smother up the evidence which the stink-pipe gives out, and sends it into somebody's house, instead of insisting upon the removal of the foul sewage from the sewer. No smell will ever arise from a properly constructed sewer; and if there be such a smell, it is conclusive proof that there is a deposit either in that sewer or in some other in close communication with it, or in the soil around it. No stagnation, either of air or of sewage, should be possible in any sewer.

Assuming that sewers are necessities in a thickly-peopled neighbourhood, they must not be allowed to ventilate into houses; and now a *third law* comes into operation, viz., that it shall not be possible for air to pass directly from a sewer into any house until it has been diluted by pure air and has had time to have its albuminoid matters oxidized. *There must not be any communication directly between the sewer and the interior* of the house.

There is no occasion for any departure from this law, and it should never be allowed in practice.

There is another danger which arises from sewers if they are not constructed of impervious materials; brick sewers are open to great objection when they pass through pervious soil in close proximity to houses. Unless they are very freely and efficiently ventilated, they contaminate the air of the subsoil of a town until it becomes a perfect hotbed of mischief. This is a frequent cause for the continuance of enthetic disease in districts in which the water-line rises and falls at distinct intervals. The way in which gases travel long distances underground is sometimes shown by the distance which coal-gas travels when a fracture has taken place in a gas main. Sewer-gases, which only form in badly constructed sewers, are just as penetrating. The products of decomposition find their way through the bricks into the soil, and then into the foundations of the houses. There are some houses in this town which are built over sewers, and which must sooner or later be dangerous to the occupants. The builders of such houses ought to be compelled to notify the fact to every incoming tenant. Ventilation should be provided in every case in which a trap has been fixed, otherwise stagnation must arise. This is another fundamental law.

The next *law is that sewage must be utilized.* It must be conveyed as soon as it is formed away from the neighbourhood of human beings. *z* is found to flourish most luxuriantly in sewage which is about to undergo putrefaction, but in which putrefaction is not actually established.

The safety, as far as it is safe, of the old-fashioned cesspool out of doors arises from the fact that putrefaction is rapidly set up, and with it all danger from the multiplication of *z* is removed. This is also seen in the dissecting-room, or at *post mortem* examinations. There is much danger from dissection-wounds for a few days after a death; but if a student cuts his finger whilst dissecting a body in which putrefaction is advancing there may be an ugly sore, but there will not be a poisoned wound. In the cesspool, *z* may be indefinitely multiplied before putrefaction is established, and germs of mischief may find their way out of cesspools into wells and water-courses, and may do much mischief. No Sanitary authority ought on any pretence to allow a cesspool to exist within its jurisdiction.

If there be no sewers, and I contend that they are not necessaries in a thinly-peopled district, excreta should be reserved in some

utensil in contact with earth or some other deodorizer able to arrest the changes which otherwise must take place, and before the power of change can re-assert itself the material should be taken away and utilized in the ground. The pail system is far safer and far more economical for a village population than a system of sewers, and it is a serious blunder to introduce into small places the works which thickly-peopled cities require; but then the work of collection must be controlled by an efficient local authority. Sewage which has been removed from the town by water-carriage must be applied at once to the land by means of surface-irrigation. This subject has been repeatedly mooted at Congresses, and by inquiries made by Royal Commissioners and Committees of both Houses of Parliament, and the general conclusion which has always been arrived at by unbiassed witnesses has been similar to that which was agreed to at the first Sanitary Congress ever held in this kingdom. In October 1866, the Leamington Sewage Congress, after a long discussion in a large assembly of scientific and practical men, agreed to the following resolution: "That the system of irrigation, when carried out in a scientific manner, removes the difficulty which now arises from the present noxious plan of polluting the rivers of England." A rider was added, which caused it to be unanimously accepted, viz.: "But that there are circumstances in which other systems may be applicable." Thirteen years have passed away since that time, and I am still more convinced than ever of the truth of the following conclusions:

1. Sewers are necessities for crowded populations.

2. Having sewers, they are silent highways along which human excreta may be safely and efficiently removed by water-carriage.

3. Sewer-gases and smells from decomposing sewage are not necessities of the system.

4. If sewage be judiciously applied to land, the spread of enthetic disease by its means becomes an impossibility.

5. After a proper application by surface-irrigation, the effluent water may be safely discharged into the nearest water-course.

6. The application of sewage to land must be conducted on scientific principles; otherwise failure, first financially, and then by producing nuisance, will arise.

7. A local board is the worst possible body to have the management of a sewage-farm. The management requires an intimate acquaintance with several sciences, with agriculture, with sale and barter, and an immediate personal command of capital: without these powers it cannot become a financial success. The manager

of a sewage-farm must be an autocrat and not be liable to those attacks which are certain to be the lot of active members in a popularly elected local board. The Croydon Local Board, with the best intentions, will have to reap the harvest which is sure to follow from the farm having too many masters; and the ratepayers of the parish who did not know when they were well off, and who are primarily responsible, will have to pay the ultimate cost.

The eighth conclusion at which I have arrived, is that a local authority, in providing for the utilization of sewage by irrigation, must be prepared to pay the difference in value between the price of the land and its ordinary agricultural worth. One penny in the pound on each rate, or at the most threepence for the year, ought to be amply sufficient for this purpose, as well as for the payment of interest on money sunk in unexhausted improvements. The Beddington farm, which has now been in operation more or less for twenty years, costs more than this; but if the farm had to be formed now, the experience which has been gained (if it were available, and if members of a local board could condescend to think that anybody else knew what was wanted better than themselves), would enable the board to carry out the work at a much less cost. I say if that experience were available; but, unfortunately, local self-government tends to scatter experience to the winds. Those works, upon which considerable sums of money have been sunk in as yet unexhausted improvements, are not followed up, because present managers do not know anything about them.

The ninth conclusion to which I have come is, that although sewage should be conveyed to the soil as rapidly as possible, *rainfall* should go to *river*. It is a wrong thing to conduct rainfall into sewers, as by this means a sewage-farm is swamped with unnecessary water. Not that storm-water from the streets of London should be sent into the Thames, or the washings of thickly-peopled cities at once into the water-way, but ordinary surface-water should be strictly excluded, and when possible, the rain-water from house roofs should go to the water-courses. This is a good reason for excluding sewers from thinly-peopled districts; ordinary sewers will only drain the subsoil, empty the water-courses, and dry up the smaller sources of our rivers, and produce as much evil in the subsoil as cesspools now do. They are serious blunders too—often perpetrated for the personal benefit of private individuals.

The sixth great law of Sanitary work is for sewer and water services to be decidedly separated, so that no interchange of either liquid or gases should be possible. It was shown not long since,

that just where a water-pipe passed over a sewer, there the pipe was defective, and as a consequence a serious epidemic arose. Sewage soon decomposes iron; and if water-pipes be allowed to lie in sewers, and to occupy portions of cesspits on the roadside, or to be in communication at those points at which water is delivered into a house and slops and sewage removed, there can be no real safety for the people. I am sometimes astounded when I hear men who put themselves forward as Sanitary authorities utterly ignore this fundamental law.

The seventh law is that the *individual house* is the unity of Sanitary work, that it is in each house, and it is with each individual that the first action must be taken to diminish the power of z to grow and produce its kind, whilst should z be introduced, it is the *individual case* which is the unit of repression. But all these canon laws have their foundation upon the particulate nature of contagia, and it is by bearing this one fact in mind that Sanitary work can produce sufficient fruit to be successful.

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On Certain Points with reference to Drinking-Water.

MUCH controversy has taken place with reference to the subject of drinking-water, and indeed we may say that no part of the wide field of Hygiene has formed more frequently the battle-ground of the partizans of different theories. Many things have contributed to this: a too great tendency to generalization from insufficient data; a too great dependence upon the dogmatic opinions from time to time enunciated;—a tendency to misrepresent the views of opponents, &c. All those things retard true progress and are apt to bring hygiene more or less into discredit. Thus it is asserted by some who are opposed to the so-called "water theory" of disease, that its supporters insist that this is the only means of propagation. I need hardly point out that this is erroneous, for I am not aware that this has ever been insisted upon by any one whose opinion has carried any weight with it. Another accusation is this: that, by demanding the presence of a germ or *materies morbi* in water, as a *sine quâ non* for the production of a specific disorder, the science of hygiene is actually retarded and attention drawn away from the necessity of having pure water at all times. Here again is, I think, a mis-statement of the case, for no one has advocated the use of impure water (if we except the address of the late Sir William Ferguson, which was an instance of an eminent man stepping out of his way to treat a subject which he had not sufficiently con-

sidered). But, on the other hand, we have been obliged to admit that in some, perhaps indeed many, instances, water undoubtedly impure has been consumed for a length of time, without positive disease being directly traceable to it. Still that is no reason why impure water should be used, and none are likely to recommend it. For we are all ready to admit, to some extent at least, two points, viz.—1. An impure water is probably more likely to form a favourable nidus for disease-poison, whatever that may be, than a pure one; and 2. It is, at least, not unlikely that the prolonged use of an impure water renders an individual more open to attacks of disease, should he be exposed to them. But there is also another side to the question: there exist cases, where the evidence seems fairly convincing, that disease has been propagated by means of water which our present means of examination fail to detect the impurity of. But in this there is nothing contradictory, for assuming for a moment the verisimilitude of the germ theory, we recognize the extraordinary minuteness of some of the bacteroid points, which tax the powers of our best microscopes to recognize them. Should these organisms be propagated by means of conidia, how much more minute must they be! And if, as has been suggested by Mr. Sorby, we have already reached the greatest power of penetration by means of lenses, it is quite conceivable that we may never see a germ, even supposing it positively exists. It will also be evident that, if microscopic investigation fail to reveal its existence, still less can we hope much from chemistry in this direction.

It must not, however, be understood from these remarks that I look upon either chemical or microscopical research in this direction as valueless; on the contrary, I think they are of very considerable value, but the value has, in my opinion, been both overrated and underrated. Thus, it has been overrated when chemists have proposed to lay down certain hard-and-fast lines as to the quantity of constituents to be considered as admissible; whilst it has been underrated by those who, disgusted and discouraged by an overweening dogmatism, have given up chemistry and the microscope in despair. What, then, is the position that the examination of water occupies at the present time? First, with reference to the chemical question. The most important is undoubtedly the quantity and nature of the organic matter, and any condition of the water that may influence its changes or action. Various plans for its estimation have been adopted, but I purpose to direct attention only to the so-called albuminoid ammonia method, and to the use of the permanganate of potassium. Those two are the easiest of application on the whole, and if intelligently applied they give information of some value. The former plan has been extensively used in this country, the latter being more commonly employed abroad. Following the limits laid down by Professor Wanklyn, it has been customary to adopt 0.08 of a part per million as the limit of albuminoid ammonia in a first-class drinking water, any waters going beyond 0.10 being considered as dirty waters. Indeed, Mr. Wanklyn goes so far as to look suspiciously upon a water with more than

0.05, if there is a notable amount of free or saline ammonia. In a good many instances this rule has been applied with some rigour, and water has been condemned unhesitatingly when judged by it. But it is obvious that this method tells us little or nothing of the *nature* of the organic matter, and, chiefly, whether it be vegetable or animal. When the albuminoid ammonia is well marked and we have at the same time a good deal of free ammonia, the conclusion usually drawn is that the contamination is animal; on the other hand, in the absence of the free ammonia, it is assumed to be vegetable; and the question is still further modified by the presence or absence of chlorine. But, supposing we do assume that the organic matter is vegetable, is this sufficient? By no means; in some cases vegetable matter has been shown to be at least *probably* hurtful, in the way of inducing diarrhœa, &c.; but in others a considerable quantity may exist without any harm resulting. This is especially the case with *peat-waters*, which contain a large amount of albuminoid ammonia, and would be condemned by some chemists on that account, If we did so, however, we should have to condemn a large part of the water-supply in Ireland, and, in my opinion, very unreasonably. For instance, a number of samples from that country have come from time to time into my hands, with reference to the water supply for the troops; but where I was satisfied that the organic matter was of peaty origin, I have not condemned the water, even although the albuminoid ammonia was large. Thus: a sample from the water-works supply at Waterford yielded no free ammonia, but 0.28 of albuminoid: samples of the Vartry supply from Dublin Barracks yielded 0.132 and 0.156 of albuminoid without any free ammonia. I am afraid some chemists would have condemned those samples, but feeling satisfied that it was vegetable matter, I did not feel myself justified in doing more than pointing out that the filtration at the Company's works was imperfect, as indicated by the somewhat numerous organisms shown by the microscope. Again, with reference to the permanganate test; this we generally use at Netley with sulphuric acid and heat, reckoning the results as so much oxygen required for the destruction of the organic oxidizable matter, taking care to separate this from the nitrous acid. As a limit, 1.0 milligramme per litre may be laid down as a general guide, but much latitude must be allowed: thus the peat-waters above alluded to yielded from 1.14 in the Vartry to 3.0 in the Waterford supply. Such a quantity would be very objectionable with animal impurity, but is probably innocuous with vegetable.

It may therefore be stated as a general principle, roughly applicable, that, if we can be fairly assured that the impurity in a sample of drinking-water is vegetable, the limits usually laid down may be considerably exceeded without it being incumbent on us to condemn the water. But now comes a second question. Is this true of all vegetable matter? We may take it as generally true of peat or moorland waters, but under some circumstances it may not be true. It would, for instance, not be true in the case of contaminations from marshes of a malarious character, where I should

be inclined to make the limitation decidedly narrow; or in contamination with vegetable matter from malarious districts, such as is reported by Dr. Smart in the Rocky Mountains country, or where poisonous plants abound, &c. In the case of the Leek workhouse, Professor Wanklyn believed diarrhœa to have been caused by vegetable contamination; this may have been the case, but the evidence seems inconclusive.

The next point of importance is the significance of free ammonia, or saline ammonia, as it is sometimes called. Here the limit has been put very low, only 0·02 parts per million. When present along with albuminoid ammonia, but without much chlorine, it is taken to show contamination with sewer-gas as probable; with a marked amount of chlorine and albuminoid ammonia, contamination with sewage; with little or no albuminoid ammonia, but with a good deal of chlorine, contamination with urine; with neither albuminoid ammonia nor chlorine, vegetable, perhaps marsh, contamination. Even assuming that those inferences are correct, it is obvious that two or more of the conditions might co-exist and so interfere with the diagnosis. But is it certain that they are correct? Not in all, I think, particularly where urinous contamination is asserted of waters containing much free ammonia and chlorides, but without albuminoid ammonia. These characters are met with not unfrequently in deep well-waters—Artesian wells, in fact, where recent contamination cannot be urged. Thus the well in Trafalgar Square yields (per million) about 0·85 of free ammonia and 165·5 of chlorine (= 11·515 grains per gallon); and its analysis, I believe, at first caused Professor Frankland to have suspicions of sewage contamination. But other wells are found to yield similar results. Thus: two samples from deep wells (about 240 ft.) at Parkhurst yielded, respectively, 0·924 and 0·936 parts per million of free ammonia—no albuminoid ammonia in one case, and only a trace in the other, and from four to five grains of chlorine per gallon. Contamination is hardly to be thought of. But perhaps one of the most curious is the instance of the Spithead Forts. From a well sunk in the outermost one, at a distance of at least two miles from land, a sample was sent to me: it contained 0·5428 per million of free ammonia, no albuminoid, and about 3·9 (grains per gallon) of chlorine. Contamination here is out of the question. But where does this free ammonia come from? It is not possible to say positively, but in all likelihood from some organic matter which has undergone conversion into ammonia, but has not passed into the farther stage of nitric acid. The experiments of Schliessing and Munz, and of Warington, have confirmed the suggestion of Pasteur, that nitrification is a fermentative process, requiring a peculiar organized ferment for its operation,—the addition of substances known to be fatal, or at least obstructive, to low forms of life being efficacious in arresting the process. In the samples in question, especially in that from Spithead, there was no sign of animal or vegetable life on microscopic examination, and we may therefore conclude that the persistence of the nitrogen in the form of ammonia was due to the absence of the ferment necessary to

complete the process of nitrification. This seems to me the most probable explanation of the apparent contamination of deep-well waters, which has been a source of puzzle to a good many people.

The above remarks tend to show that, in addition to the mere chemical knowledge of the constituents, information as to the source, its nature and surroundings, and in fact as much as we can possibly get about the water, are necessary to form a correct judgment. At the same time, the laying down of certain limitations as to quantities is useful as a foundation to work upon, and this may be seen by a reference to the table, which shows the mean of 223 samples analyzed and reported upon at Netley. Of those fifty-four were pronounced to be "fit for use," that is, no excessive impurity could be detected chemically; 103 were pronounced "usable," or "required filtration;" and sixty-six were positively condemned. It will be seen that the class of "fit" lies well within the limits laid down with reference to organic constituents, and that there is a progressive increase in the two other classes. Even in the chlorine this is also observable.

Table of the Average Amounts of Constituents in Drinking-Water according to Class. Mean of 223 *samples.*

Class.	Chlorine in grains per gallon.	Ammonia in milligrammes per litre.		Oxygen required for oxidizable organic matter in milligrammes per litre.	Nitrcus acid (No_2) in milligrammes per litre.	Hardness. Clark's Scale.	
		Free.	Albuminiod.			Fixed.	Total.
"Fit for use," or free from marked organic impurity. (54 samples.)	2·2045	0·0050	0·0258	0·3611	0·2097	5.06	12·25
"Usable," or requiring filtration before use. (103 samples.)	2·3367	0·0843	0·2062	0·8200	0·3430	5·94	11·55
"Unfit for use," on account of organic impurity. (66 samples.)	4·2612	0·4783	0·4337	0·7977	0·5927	7·71	14·68

Let us now say a word with reference to the mineral constituents. Here we find grounds for difference of opinion also, and it is much to be desired that some uniformity should be arrived at. At present we have the unedifying spectacle of one analyst declaring a water

fit for drinking, and another condemning it. A controversy of this kind is going on at this moment between two eminent chemists in London. It may be difficult to lay down any fixed rule, but something might, I think, be arrived at that would remove this discrepancy. Within some limits a difference of opinion is likely to exist, but surely a *viâ media* could be found here more easily than in the case of organic impurity. Some think a water of a certain hardness necessary, and condemn too soft water; others hold a directly opposite opinion. Some even recommend the addition of salt to water; others are inclined to condemn water with even a moderate quantity of salt. In one case the sample is condemned by one chemist as unfit for washing, but allowed to be fit for drinking; whilst another condemns it for both purposes. I have myself a small experience in this direction. A series of samples lately submitted to me I felt obliged to condemn as an ordinary water-supply, on account of the large amount of mineral constituents, such as more than 140 grains per gallon of solids, of which at least 85 were chlorides and 10 were magnesia: fixed hardness 49 degrees of Clark's scale. Of this water I said that it might be used in case of great emergency, but that as an ordinary water-supply it was very unadvisable, especially in the case of children or the sick, in whom it would be apt to produce diarrhœa and perhaps aggravate other diseases. It was also, I reported, unfit for washing purposes on account of its hardness. I may mention that the source of the water was near the sea and that it was free from organic impurity. A sample was sent to an eminent analyst in London, whose analysis agreed in the main with my own; but the conclusion he drew was that it was a good water fit for all domestic purposes. Now, what is the public to think of those discrepancies? Is it likely that confidence will be placed in analysis, or is it a wonder that people should declare that chemists— water-analysts especially—and their work require rehabilitation?

On the other hand, difficulties arise, which analysts have to contend with, in ways that are but little appreciated by the public. For instance, I have had samples of rain-water sent to me, which proved full of various kinds of impurity; but I have had some difficulty in getting it admitted that such a thing was possible. "But it's rain-water!" people say: very true, but still it is impure. We might further answer, that for the matter of that, all water is rain-water, but the preservation of its purity is a question of collection and storage, whether these be done by nature or by man. Of the cases of contamination that have come within my observation the following are a few: by spray from the sea, by soaking from salt marshes into the collecting tanks, by smoke products and house refuse, by taking up caustic lime from the cement of tanks, by pigeon-droppings from house roofs, &c. These are only some, and not the most dangerous, sources of impurity. Another source of difficulty is carelessness in collection of the samples. A case illustrating this recently occurred to me. Samples from the top and from the bottom of a well were sent for examination, two bottles of each. The bottom sample and *one* of the bottles of

the top sample were fairly good, but the second bottle of the top sample was dirty and offensive, the sediment apparently consisting entirely of fatty matter. I reported that the two samples seemed from the same source by the mineral analysis, but that probably something had got into the one in question at the time of collection, assuming the bottle to have been clean. On inquiry it turned out that to obtain the sample a man had to be sent down the well with a candle, the tallow of which had quietly dropped into the well and been carefully bottled off with the sample! Still another difficulty arises from want of care as regards cleanliness of the vessels in which the samples are sent. I have had some sent in old pickle-jars, castor-oil bottles, turpentine bottles, physic bottles of all sorts, with corks of a very ancient and fish-like smell. To analyze such samples is simply a waste of time.

The best of all examinations is that which is made by the analyst on the spot itself, at the very source of supply. If that be impossible, then the most scrupulous care should be taken about the collecting of the sample and its transmission in clean glass-stoppered bottles, with every detail of information that can possibly be furnished.

I should have wished to say a few words about the microscopic examination of water, but my paper has reached the prescribed limits, and I will therefore merely urge the importance of not neglecting this branch of the inquiry. It may be said that it has not as yet done much for us—still it does furnish us with some information; and if we desire more, it is only by persistent observation and carefully noting what we see and the circumstances under which the objects are seen, that we are likely to extend our knowledge in this direction.

FRANCIS S. B. FRANÇOIS DE CHAUMONT, M.D., F.R S.

Interpretation of Water Analysis for Drinking Purposes.

DR. SWETE to some extent travelled over the same ground as Professor F. de Chaumont. The earlier portion of his paper was occupied with an account of the different processes employed for the determination of organic matter in water, and a discussion as to the value or advisability of each in a Sanitary point of view. He then proceeds as follows:—

"Now having gained these chemical data, will they be sufficient without further observation or knowledge of the source of supply to enable us to give a reliable report? I may answer, Yes, in bad waters, for there the data will be in excess, and there can be no reasonable doubt in our minds; but without more general information many polluted waters may be passed over, and apparently bad waters

condemned without sufficient reason. The following extracts from notes of water anlyses in different localities will illustrate my statement :—

WATERS IN POROUS STRATA.

	Solids.	Chlorine.	Free NH_3.	ALBNH_3.
Leamington. 100 wells; 30 good.				
Lowest . .	22	1·5	·00	.07
Highest . .	216·8	19·	1·76	·48
Average .	101·7	7·4	1·50	·18
Droitwich District. 100 waters; 23 good.				
Lowest . .	36	1·5	·00	·07
Highest . .	261	52·5	1·13	·90
Average .	73	18·	·13	·20
Dudley. 7 waters; 2 good.				
Lowest . .	28	2·7	·00	·08
Highest . .	143	33·	·48	·36
Average .	87·8	13·6	·19	·19
Coventry. 10 waters; 3 good.				
Lowest . .	32	1·9	·02	·02
Highest . .	134	9·2	1·60	1·22
Average .	64·3	6·1	3·72	2·03
Nuneaton. 15 waters; 7 good.				
Lowest . .	21	1·6	·01	·02
Highest . .	119	14·5	·56	.20·
Average .	46·4	6·2	·13	·07

WATER ANALYSIS.

Worcestershire.				
Normal . .	63	2·5	·02	·08
Polluted .	64	8·0	·00	·16
Warwickshire.				
Normal . .	35	2·8	·00	·07
Polluted .	166	16·0	·08	·13
Radnorshire.				
Normal . .	11	0·7	·00	·04
Polluted .	22	1·5	·06	·10
Lancashire.				
Normal . .	10	0·6	·00	·02
Polluted .	13	0·9	·01	·08
Pembrokeshire.				
Normal . .	10	1·8	·00	·01
Polluted .	14	2·5	·04	·09

In these Tables we shall see that there is a considerable difficulty in using a hard-and-fast line in the interpretation of results. Prof. Parkes states that the total solids of a wholesome water should not exceed 8 grains per gallon, unless in the chalk, when he allows 14 grains. Dr. Wilson, in his well-known handbook of

Hygiene, allows 30 grains; whilst Mr. Wanklyn does not condemn a water in which the solids do not exceed 40 grains in the gallon. Now, in the first Table, there are very few waters out of 232 samples that give as low an amount of solid as even 40 grains per gallon; there are waters of surface wells in the new red sandstone containing frequently large amounts of lime salts, especially of sulphate of lime, and chlorides in excess. Were they to be condemned for this fault only, where should the inhabitants obtain their water from? I certainly do not think such waters of a high class of wholesomeness; they are very hard, but independently of this, some are largely polluted with organic matter, in consequence of which, most of these wells are now closed and a town supply of good water substituted. In Leamington nearly all these wells are closed, and a deep Artesian well substituted; the same may be said of Coventry. In the urban district of Droitwich, a new supply from a pebble drift under the marls, giving a water of a high degree of purity, has just been opened.

The chlorine has frequently been supposed to be indicative *per se* of sewage contamination, but in the first Table the chlorine is for the most part excessively high, and yet 65 of these waters are uncontaminated. The new red sandstone being a salt-bearing stratum, on the other hand, in the second Table, some of the waters not exceeding 2·5 grs. of chlorine to the gallon, have been directly polluted with typhoid excreta. The ammonia, especially albuminoid, will also be found to present much the same results. Mr. Wanklyn states that water from ·05-·10 of albuminoid ammonia in the million parts is a safe water, from ·10 upwards dirty and suspicious, but the water should be absolutely condemned if it reaches ·15. I agree with the latter sentence, but the *safe* waters I think are often open to grave suspicion. The second Table is drawn up to show that no hard-and-fast line can be entirely depended on in interpreting the Sanitary value of the amount of albuminoid ammonia. I have, in various counties, contrasted the amount of albuminoid ammonia which has appeared to me to be normal with that obtained from a water which I have reported as polluted. In Worcestershire and Warwickshire I have taken wells in which, although there is undoubted pollution, no illness has resulted from the use of the water; whereas in Radnorshire, Lancashire, and Pembrokeshire I have contrasted the normal water with that of a well which has been the direct cause of an outbreak of typhoid; that in Radnorshire, remarkable as a well apparently removed from all sources of pollution, was evidently the cause of a severe and fatal outbreak of typhoid, inspection showed it was contaminated by the overflow of a brook during flood, into which, at two miles' distance, typhoid excreta had been freely thrown. Now, in these three examples the albuminoid ammonia was only ·10, ·08, ·09; so that at the most they would only have been considered suspicious, and most probably been reported wholesome. This was certainly the case in the Pembrokeshire well, which in three analyses was reported to be a good water. All these analyses have been made of wells I have personally inspected, and seen the

source of pollution. By contrasting the analytical result with the normal water, the extra amount of albuminoid is much the same as in the cases alluded to in Warwickshire and Worcestershire.

Warwickshire	.	Normal Albuminoid .	·08
·08 + ·08	=	Polluted Well . .	·16
Worcestershire	.	Normal	·07
·07 + ·06	=	Polluted	·13
Radnorshire .	.	Normal	·04
·04 + ·06	=	Polluted	·10
Lancashire .	.	Normal	·02
·02 + ·07	=	Polluted	·09
Pembrokeshire	.	Normal	·01
·01 + ·08	=	Polluted	·09

The two former wells being in porous strata, the three latter in a hard impermeable stone. I think these examples will show the value of actual inspection of the water, or at any rate of reliable information as to its surroundings, and of obtaining, if possible, a knowledge of the normal condition of the water of the district. The free ammonia also must not always be referred to sewage. In the mineral springs of Radnorshire and Brecon I have found a large quantity of free ammonia under surroundings that preclude any suspicion of contamination. The fact is, that this ammonia occurs from volcanic action, the mineral springs arising from the contact of trap rocks with the slate and the decomposition of sedimentary deposits.

Deep wells also contain nitrates, especially in the chalk where the previous sewage contamination is certainly prehistoric. The moist combustion process also gives us curious information at times. I recently examined a well-water which gave as much as 72·5 milligrammes of oxygen to oxidize the organic matter in a litre; this water was polluted as well with nitrogenous matter; this great amount on inspection of the well proved due to the decay of an old wooden pump in the well—ordinary polluted waters requiring from 5 to 7 parts per million of oxygen. Another water under similar circumstances required 62·5 of oxygen to the litre.

I think the knowledge of the surroundings of a water so important that in my own district I have supplied the inspectors with the following label, taken from a form prepared by Dr. Cornelius Fox:—

Droitwich Rural Sanitary District.

Sample for Analysis.

Date of Collection . . .
Source . . . . . .
Depth of well . . . .
Nature of soil . . . .
Distance from nearest source of pollution . . . . .
Why complained of . . .

Many people think that by withholding information they will get what they call an independent opinion. This is quite right in the analysis of adulteration of food, but with water the more information given to the analyst the more reliable will be the opinion given.

Time does not allow me to touch upon the microscopical appearance of the deposit. The value of this must be apparent to everyone; but it is not easy to give all the information we may wish in the short space of twenty minutes the Congress allow for a paper. I have endeavoured to avoid partizanship and to give every analyst his fair due—I only trust that in my desire to be as concise as possible, I have made the matter sufficiently clear to you.

HORACE SWETE, M.D. (C.S.S. CAMB.).

Professor WANKLYN expressed his satisfaction with the papers, and entered into some scientific details. He congratulated Dr. Swete on the results he had obtained. He said the objection raised to his process, that it did not account for all the nitrogen, was based upon a misconception. He then explained what changes took place.

Dr. STRONG mentioned that at a public institution with which he was connected an outbreak of diarrhœa occurred, and it was very difficult to trace it to its source. Eventually, however, he found there were some wells which had been used to collect the rain-water from the roofs. He therefore had the wells cleaned out, and ordered that the water should be used only for washing purposes. Well, later on diarrhœa broke out again, and he found that one old gentleman had persisted in drinking the water because he said it made the best tea. As the only method of getting rid of the danger, he (Dr. Strong) had now ordered the wells to be filled.

A MEMBER OF CONGRESS—Did the old gentleman who drank the water have the diarrhœa?

Dr. STRONG—Yes.

The MEMBER—Was he the only one?

Dr. STRONG—No. I found others had drunk the water besides him, but he was a particularly obstinate old man, and would probably have preferred to have the diarrhœa, to giving up his good tea.

Dr. TATHAM (Salford) asked if any evils had been traced to the use of neglected filters.

Dr. JACOB (Redhill) make some remarks on a recent outbreak of typhoid, caused by water supplied by the Caterham Water Company.

After some remarks from other gentlemen,

Dr. CARPENTER said that as long as a water supply was pronounced pure by the chemist and microscopist, those who had that supply might drink it safe from the chance of producing disease in their system as an epidemic. He was not speaking of cases now arising now and then, because he believed a very few of the disease-producing particles would induce disease if swallowed by persons

susceptible of it, but if there were sufficient particles to produce an epidemic the chemist was certain to discover it.

Professor De Chaumont, in the course of his reply, said he had certainly known bad results to follow from the use of neglected filters. The charcoal became clogged with organic matter and after a time turned out to be a source of injury instead of benefit. In his opinion filters unless frequently cleansed did more harm than good.

Dr. Swete, in his reply, said there was no simple popular test of water which he could recommend. He believed, however, that the difference between animal and vegetable pollution could be detected so freely as to suggest fuller examination. The only safe plan was to have a complete chemical analysis.

Preventable Mortality. The Mortality from Alcohol.

Till about two years ago I laboured under the impression that the statement, that 60,000 victims to intemperance died every year in the United Kingdom, was a wild and unwarrantable exaggeration. But on applying my own medical experience with that of several medical friends, to the total number of practitioners in three kingdoms, I was most relunctantly forced to confess that by no reasonable reckoning could I estimate our annual mortality from intemperance in alcohol at less than 120,000 souls, of whom 40,500 succumb through their own personal indulgence, and 79,500 through poverty, disease, accident, or violence springing from the indulgence of others. This estimate has been widely and fully criticized all over the country, but its accuracy has not yet, I regret to say, been questioned; many high authorities such as Dr. Hardwicke, Coroner for Central Middlesex, and many well-known Medical Officers of Health having pronounced it "extremely moderate" and "far under the truth."

This computation was based on the number of medical men in practice being assumed to be 16,000; but, from an undertaking recently completed, I find that the actual number is a little more than 18,000. The same ratio as before applied to 18,000, the true number, instead of 16,000, the supposed number, would give an annual mortality of 134,499, of which 45,562 would die from personal intemperance, and 89,437 from the consequences of intemperance of others.

The calculations of Dr. Thomas Morton point to a mortality of fully 60,000, whilst the late Dr. Lankester estimated the deaths due to excess in drink as 67,000 in 1877. My own practice during the last twelve months indicates (with every possible deduction) a mortality of 57,600.

The annual rate of mortality per 1000 between the ages of twenty-five and sixty-five among clergymen is 11·7, while among publicans, beer-sellers, and wine and spirit merchants, it is 26·64.

It may be objected by those unacquainted with the facts that, in the Registrar-General's Fortieth Report, only 1146 persons appear as having died from alcohol in 1877 in England and Wales. All who are familiar with the subject know that the Registration Returns are no criterion whatever of the prevalence of drunkenness as a prime factor in the causation of death. In the present certificates of death medical practitioners are called upon only to state the disease from which death occurs, and are not asked what has caused the disease. Of the many members of the profession whom I know, not one ever hints at alcohol in the death certificate, unless in those cases in which the name of the fatal disease, such as delirium tremens, in itself is an evidence of the operation of this narcotic poison. Our death certificates are not at present liable to publicity, and the proclamation to the sorrowing survivors and to an inquisitive public of the secret drunkenness of some loved and respected deceased, would but ruthlessly harrow the feelings of the former and pander to the idle curiosity of the latter. Were, however, all deaths certified by some medical expert, independent of private practice altogether, or were the history of the origin of the disease that has cut short the life treated as a confidential report for purposes of Public Health, we should arrive at a much closer approximation to the actual causes of preventable mortality than we have any possibility of doing at present.

So much for the mortality from the intemperance of the slain by alcohol. But the preventable mortality from drinking embraces a much wider range. For every one whose life is shortened by his own immoderate indulgence in drink, probably at least two innocent lives are sacrificed.

Children are killed by suffocation through the drunkenness of their parents; both mothers and infants die for want of proper sustenance and decent clothing and shelter on account of the head of the family wasting his money in drink; and numerous violent deaths are due to drunkenness. Mr. Payne, the coroner, remarks that "if it were not for the drink, the services of a coroner's jury would be but seldom required."

The influence of alcoholic indulgence in the death-rate was well illustrated in the city of Glasgow towards the end of the first quarter of the present century. In 1821 the number of deaths, from Cleland's Tables, was 3686 and in 1822 was 3690; but in 1823, when the reduced duties on distilled spirits began to operate, the mortality rose to 4627, and in 1824 to 4670.

The sway exercised by alcohol on the rate of mortality is clearly shown in the following Table extracted from the Fortieth Report of the Registrar-General.

Mean Annual Rate of Mortality in England from each Class of Causes for two Quinquennials, 1865-74; *also Rate of Mortality in the years* 1875, 1876, *and* 1877.

Classes.	Causes of Death	Annual Deaths to 1,000,000 Living.				
		5 Years 1865-69.	5 Years 1870-74.	Year 1875.	Year 1876.	Year 1877.
I.	Zymotic Diseases	5171·8	4849·2	4473	4005	3559
II.	Constitutional „	4154·4	3777·6	3775	3627	3613
III.	Local „	8887·2	9165·6	10373	9505	9450
IV.	Developmental „	3605·0	3367·4	3290	3045	2940
V.	Violent Deaths	797·4	751·6	793	762	723

From this Table it will be seen that in every Class save one the mortality has steadily and remarkably diminished; but in Class III the mortality has, up till the year 1876, as steadily and markedly increased. In this Class the principal increase has been in deaths from diseases of the brain and nervous system, of the organs of circulation, of the respiratory organs, of the liver, and of the kidneys. These are precisely the organs most apt to be seriously affected by excess in alcohol; and it is a significant fact that since the diminished consumption of intoxicants, from the combined influence of the pressure of hard times and the rapid spread of temperance principles, beginning with the year 1876, there has been a decrease each year in Class III.

I prefer to limit the present inquiry to the influence of the excessive use of alcoholics on the mortality, inasmuch as this is a department of the investigation in which we can all work. This paper has reference, then, to deaths from immoderate drinking alone.

Is there any possibility of arriving at the truth, and if so, what is the most accurate method of inquiry? We can never hope to trace out the whole deaths occasioned by alcoholic excess, as secret inebriates almost invariably conceal and deny their besetting sin, and the period of medical attendance is often too brief for the detection of the truth. But there is no reason why we should not be able to come at the greater part of the actual mortality. We who have hitherto essayed to methodically investigate this important question are too few (but two attempts having as yet been made on a scientific basis), to warrant the application of the results of our inquiries to the entire death-roll of the country; but if 500 medical men in active practice, in different parts of the kingdom, some in city some in country practice, were to keep an accurate record of the causes of all deaths occurring in their practices for a specified period of twelve months, the ratio so obtained might be applied both to the total number of deaths and to the total number of medical practitioners.

Let the true fatality from alcohol be what it may, it is wholly unnecessary. The use of intoxicating liquors, as beverages, is indispensable neither to our existence nor to our happiness. We are surely ever open to sufficient and unavoidable dangers to persons and to life, without cherishing at our domestic hearths and honouring in our most sacred festivals so poisonous and deadly an article, manufactured by human ingenuity, at the expense of the destruction of enormous quantities of the food supply so essential to the preservation of the Public Health. The enlightenment of the public mind on the fearful amount of preventable disease and death wrought by the ravages of alcohol is an appropriate mission for a Sanitary Congress, and will greatly aid in arousing that popular sentiment which alone can effectually stamp out this easily preventable mortality by the social ostracism of the offending artificial poison and the speedy enactment of efficient prohibitory legislation.

NORMAN KERR, M.D., F.L.S.

The Relation of Alcohol to Bad Sanitation.

It has been frequently alleged that bad sanitation is one of the chief causes of intoxication which so largely prevails in this country. There can be no doubt, I think, but that insanitary conditions of life do in many cases lead people to resort to alcoholic liquors, but we underrate the wonderful difference which is occasioned by time and habit. The following fact will illustrate this.

The Corporation of London has a considerable amount of property near Londonderry, consisting mainly of land upon which small cabins are built, tenanted by farm-labourers. On account of certain representations made to the Corporation, a deputation was sent to see whether these dwellings were fit for human habitation. They were found to be wretched hovels unfit for human habitation, and orders were given that new, commodious and well-ventilated cottages should be built. [Photographs were exhibited.]

On the occasion of their next visit they asked their tenants if they liked their new homes, and several at once replied that they did not like them at all, and " might they go back to the old ones." " What was it they did not like?" " Well they were not used to going upstairs to bed, and it was so cold without the pig." It was ultimately found absolutely necessary to pull down the old shanties if the new commodious cottages were to be used, and this was finally done, to the great annoyance of the peasants.

If good sanitation were an efficient preventative of intoxication there ought to be very little in healthy homes. I need hardly say that we are disagreeably disappointed here. Further, I have made

inquiries among the blocks of model dwellings erected in various parts of London, and I find that, on the average, four per cent. of the adult population are notoriously addicted to the excessive use of alcohol.

That the employment of alcohol as a habitual beverage, other things being equal, increases the susceptibility to disease, and its total amount and duration, is shown by the following facts :—

1. It has been repeatedly observed that when epidemics of such diseases as cholera and yellow fever have been prevalent, those who are known to be drunkards are much more readily attacked, and far more frequently succumb, than the general population.

2. The London Grand Division of the Friendly Society known as the Sons of Temperance is composed of working men of all trades save those connected with liquor. During the seven years, 1871-8, there were, on the average, about 1200 members. During those years there were 5 days of sickness for every member in each year. In contrast with this we find the Manchester Unity of Oddfellows averaging 7.7 days per member. This contrast would be even greater could we eliminate the reformed drunkards from the Sons of Temperance and the teetotalers from the Oddfellows.

3. Dr. W. B. Carpenter some years ago adduced the Government returns of the sickness of the European troops of the Madras Army for the year 1849, in which the men were classed as total abstainers, temperate, and intemperate: these showed that the relative proportion of those three classes admitted into hospital for disease was 130, 141, and 214 respectively, and the mortality as 11, 23, and 44. Later statistics fully corroborate these results.*

That alcohol should tend, when imbibed, to increase the liability to disease is not to be wondered at when we reflect that it acts in direct opposition to the recognized object of all good sanitation. The great end of Sanitary Science is to secure the removal in the speediest possible way of the effete products of vegetable and animal life. The great natural means for this end is *oxidation*. The effect of alcohol in the system is to check oxidation.

That alcohol is prejudicial to all growth and development—that is, to healthy life—may be shown by a simple experiment. If the seed of cress be sprinkled on earth in separate pots, or on flannel, and watered every day with pure water in one case, and with water containing respectively ½, 1, 2½, 5, and 10 per cent. of alcohol (rectified spirit), it will be found that even the weakest of these alcoholic liquids exercises a marked deterring effect on the growth of the cress; the 10 per cent. solution just permits the seed to swell and in some cases to sprout a little, but, if continued, finally kills the seed ; the others exert a malign influence in proportion to their strength, the 5 per cent. just permitting growth in a feeble and etiolated condition. By simply covering the growing seed with a glass cover, so arranged that the condensed alcohol and water ran back to the seed, I find that water containing only ½ per cent.

* Annual Report of the Soldiers' Total Abstinence Association for the year 1877-78.

of alcohol thus continuously operating produced as great a detrimental effect as water containing 5 per cent. applied intermittently; and that $\frac{1}{4}$ per cent. of alcohol, $\frac{1}{8}$ per cent., and even $\frac{1}{16}$ per cent., all hindered growth in exact proportion to their alcoholic strength. [Specimens were shown.]

It is unnecessary to specify the diseases which are frequently caused by alcohol. I would rather insist on the influence it has in rendering disease more frequent, more persistent, and more fatal. If required to state the least quantity which would be thus injurious, I must acknowledge myself unable to do so. But, as sane Sanitary reformers, we are always advising the people to adopt the best possible Sanitary arrangements, and I do not think any of us would recommend men to be satisfied with a very slight amount of atmospheric impurity or of sewage pollution, where pure air and pure water were easily obtained, or the impurities easily avoided. On this ground it seems to me advisable to urge on healthy human beings the strictest avoidance of such an anti-Sanitary agent as alcohol.

J. James Ridge. M.D.

On the Importance of Thorough Ventilation in Dwellings.

The importance of efficient ventilation of our dwellings has been so often insisted upon, and the subject of ventilation itself so frequently written about, that I hardly know what apology to offer for my appearance before you to-day; yet when we consider the sums that have been spent, the volumes that have appeared from time to time, and remember that the whole question as to the proper method of ventilation is still one which is in its infancy—I might say unborn, inasmuch as the best method of conveying fresh air to an apartment and modifying the supply according to the number of individuals present, is still undiscovered—my remarks may not appear inopportune.

I have no new scheme to offer, have invented no machinery or apparatus: I propose to consider only the means which are open to all, whether inhabiting the cottage or the mansion, and to lay down certain broad principles which each one may act for himself. I shall therefore speak—

1st, Of the theory of good ventilation;

2ndly, The effects of bad ventilation;

3rdly, How best to secure it when deficient or defective.

Now what do I mean by the theory of ventilation? I came across a passage in a paper—by, I think, Mr. Crookes—some time ago which struck me very forcibly at the time, viz: "That no disease can be thoroughly cured when there is a want of proper

ventilation." But though this is an important reason for attention to the subject, there is one still more urgent, even life itself; for without a constant supply of fresh air to the lungs, the blood cannot be properly oxygenated, and changes occur which will be better dealt with later on.

A few remarks on respiration are a necessary preliminary to our subject.

As you all know, the air which is inhaled loses a certain quantity of its oxygen in passing through the lungs, and the exhaled air contains an increased amount of carbonic acid.

This carbonic acid rapidly renders the air unfit for respiration; in fact, when it reaches the proportion of six parts in 10,000 of air, according to experiments made by Professor de Chaumont, one of the Council of the Sanitary Institute, organic impurities become perceptible. Calculating from the number of inspirations per minute, and the percentage of CO^2 contained in the expired air, it is found that each individual renders 3000 cubic feet of air impure in the space of an hour.

The problem which ventilation is called upon to perform, is to introduce a constant supply of pure atmospheric air, without causing inconvenience as to temperature or draughts, and the amount of air necessary to keep the standard of ·6 is well shown in this diagram, drawn out by the late Professor Parkes. He also shows that when the amount of CO^2 exceeds the standard of ·6, the air becomes close and then decidedly unpleasant. At the House of Commons a minimum of thirty feet per minute is allowed, increased to sixty feet, as occasion may require.

Now an ordinary candle acts in the same way as a human being, both consuming the oxygen which sustains life and both giving out the CO^2. If the candle be placed under a large bell-glass, the light will gradually grow dim and finally go out, the oxygen has been consumed, burnt up, and the candle is extinguished by the CO^2. Now tilt up the bell-glass a little, the CO^2 being heavier than the atmospheric air will fall to the bottom and be forced out below by the entering pure air.

If I had two tumblers, one with a small light burning in it, and the other tumbler filled with the CO^2, I could pour the gas from the one vessel to the other and the light would at once be extinguished. The same effect would be produced if oxygen were drawn out by means of the air-pump.

What, then, is thorough ventilation? A supply of pure atmospheric air in sufficient quantity to neutralize gases derived either from the breath of individuals—combustion of various kinds—or foul exhalations from extraneous sources; as soon as the equilibrium between supply and demand of fresh air is disturbed, and the balance is on the wrong side, then we get deficient ventilation.

How often do we see a large room in a house replete with every comfort and commodious, a large chandelier with several gas-burners suspended from the ceiling and perhaps a dozen persons occupying the room. There is at first plenty of air, but when the

gas is lighted circumstances are widely different. We have—say, five jets, each burning three to five cubic feet of gas per hour; now each of these jets will consume as much of the oxygen of the air as five persons; multiply this by five, will give an equivalent of twenty to twenty-five persons and with the ten actually present thirty-five. Now imagine what must happen—a feeling of languor, lassitude, and weariness comes over the visitors, each one in turn begins to yawn and a general feeling of *malaise* supervenes, then headache.

What do we find every Sunday evening at church?

It frequently happens that from motives of convenience gas is used to warm the building; it is therefore lighted some time before commencing service. On our first entering the church the air strikes hot and unpleasant, but we soon get accustomed to it and feel tolerably comfortable, till that painful feeling of drowsiness comes on which I am sure everyone here has felt several times in his life. This is generally put down to the quality of the sermon, but the preacher is unduly blamed; it would have been the same had he the oratory of Demosthenes, the fault is elsewhere.

I do not believe there is a place of worship in the kingdom which is properly ventilated; our public places of amusement, our courts of justice are just the same.

If we were asked to sit side by side with two men just fresh from some noxious or unwholesome employment, many would hesitate, yet we perhaps sit for hours in a crowded room with a far worse state of things.

A number of persons congregated together with foul breath, some not over-clean in their persons or their garments, perhaps suffering from disease; we instinctively shun the dirty garments, but breathe that which is much worse deleterious and loathsome.

This is the age for education, and Board schools with handsome exteriors are rising everywhere, but is the same care taken of the interiors, that the proper cubic space required for each child is provided? Many children, especially in very poor neighbourhoods, are not so cleanly either in their persons or garments, and it is the highest degree incumbent upon our School Board that they should carefully see that the cubic space necessary is secured, and that there should be the means at hand for the whole atmosphere to be constantly changed. In large schools I would have every window opened by an arrangement similar to that provided in a greenhouse, where by moving a lever the whole of the lights can be opened at one time. Now if this could be done, and the room cleared of children in the middle of the morning and afternoon, there would be a considerable gain to the teacher and the taught, many impositions would be saved, and the child would learn much more readily.

Bedrooms: how important that these should be well ventilated. During sleep the nervous power is exhausted; it is essentially a period of reparation when oxygen is being stored up for use later on. Less CO^2 is given off during sleep than when awake, and it is well that it should be so; for if a person under ordinary circum-

stances were enclosed in a room eight feet square, all excess of fresh air being excluded, he would be moribund in twenty-four hours.

We often hear, "I would not sleep in a room without a fireplace on any consideration," and yet how frequently is the fireplace stopped up by a board or the register down. I am often told, "But I sleep with the bedroom door open." Now there cannot be a greater mistake than trusting to this alone; it is of course better than having it shut, but unless there is an outlet for the foul air there can be no inlet for pure air. A room will only hold a certain number of cubic feet of air, and this cannot be displaced unless there is pressure or a current from without. I was gravely told the other day by a man of no mean attainments (and to whom I pointed out that the register of the stove in his bedroom was closed, and his room very ill-ventilated and unpleasant), that he was a bad sleeper and he knew he slept better when his room was close! What more fruitful source of consumption is there than sleeping in a small ill-ventilated and perhaps crowded bedroom? Our barracks and men-of-war have demonstrated this.

Lately attention has been drawn to the condition of the bargemen on our canals, and it would be as well if our legislators could attack the travelling vans which frequent fairs, &c., often inhabited by a family, when there is less cubic space than is required for one person.

Many offices in London where the buildings are crowded closely together and lit up by gas are very unhealthy, and employers would do well to pay more attention to their ventilation. Our railway carriages, as a familiar illustration, require better ventilation. If you are travelling a few miles without a stoppage in a carriage three parts full, how many of the passengers have taken a nap before arriving at their destination. All these are examples of the effects of CO^2 on the system.

We will now consider the third point,

How best to secure it (good ventilation) when deficient or defective.

When I first commenced writing this paper I was anxious to measure the velocity of various currents by an air meter, and I was unaware that there existed such a beautiful little instrument as the one I have before me, constructed by Mr. Casella for the late Professor Parkes—one who will always be remembered with gratitude by all workers in Sanitary Science as the author of the most valuable work on Hygiene we at present possess.

With this air meter I made a few experiments in different sized bedrooms, and with the doors in different positions, which demonstrated that whether the room door was closed or open there was always a current of air with varying velocity up the chimney, averaging 1 to 1½ miles per hour; for instance, at midnight on Saturday last the air meter stood at 173,740, and at 8 o'clock on Sunday morning the reading was 209,708, showing a difference of 35,968, to which 14,400, the correction to be applied to this particular air meter for that period has to be added; giving a total

of 50,368 as the number of feet of air which an ordinary register stove passed through her aperture in eight hours, or a column of air nearly a mile and a quarter in length per hour. The day previously gave also about 1¼ mile.

A similar experiment two days earlier, the rate at which the air was passing gave almost exactly one mile per hour.

In a dining-room with two gas-burners, the fire nearly out and the door closed, the velocity was increased three-fold, but when the door was widely opened and cold fresh air was drawn in from the passage, as the air in the chimney became more cool, notwithstanding the extra draught, each experiment showed a gradually decreasing velocity. I mentioned at the commencement that I had no new apparatus to describe, I have therefore carefully avoided mentioning the numerous ventilators which have been advocated from time to time. Some are ineffective, some costly, others are only useful under particular conditions, whilst many, though they allow the ingress of pure air, do not so direct the current as to provide that the cool fresh air from without shall mix with the heated atmosphere of the room and the occupants not be exposed to a draught.

To epitomize: to have thorough ventilation, the air in an apartment must be frequently changed, to effect which there should be a communication with the external atmosphere. The foul air whether caused by combustion, the CO^2 derived from the breath of persons present, or from noxious effluvia, must be got rid of; and as the result of the few experiments I have made and other observations, I consider that under ordinary conditions there is no better ventilator, more especially if assisted by a fire, than the ordinary chimney. Some means should, however, be devised for getting rid of the products of combustion derived from burning gas. I think it is more especially under the latter condition that mechanical contrivances are demanded.

I may add, in conclusion, that in registering with the air meter the results were carefully noted, but I do not pretend that they were done with strictly scientific accuracy, at the same time they were verified by my friend Mr. Cushing, who was kind enough to assist me in the matter.

H. J. Strong, M.D.

Infant Mortality.

It is the object of this paper to bring to the notice of the public a few points having an interesting connection with the annual rate of infant mortality.

To justify myself in thus taking up valuable time I need only point out the high rate of mortality in the first year of life.

In 1877, 451,896 male children were born and 67,616 died under the age of one year, or about 15 per cent.

In the same year, 436,304 female children were born and 53,201 died under one year old, or about 12 per cent.

In the first case, the deaths of the male infants represented 25 per cent. of the whole mortality occurring among males, which was 260,567.

And in the second case, the deaths of the female infants represented 22·17 per cent. of the whole mortality among females, the latter being 239,929.

Having shown the mortality among infants to be frightfully great, I shall now proceed to point out three causes which, in my humble opinion, conduce to this result. But I would first wish to state that my experience, such as it is, has been gained from medical practice among the lower and middle classes of this town and South London.

Cause 1st.—Deficiency in quality or quantity or unsuitability of nourishment given to infants.

The lower and middle classes as a rule suckle their infants, but unfortunately they also feed them by means of the bottle or spoon.

This is done generally for one or two reasons—

(1) Either they are led by the baby's constant fretfulness or constant hunger, due often to indigestion, to think that their breast milk is not sufficiently nourishing or satisfying; (2) or, they feed them to provide nourishment for their infant during their absence, often for many hours daily, at work or elsewhere.

The first reason prevails very much among the poorer classes, who seem to ignore the fact that breast-milk was provided for the nourishment of their offspring. And so many patent foods are now advertised and puffed, that the opinion seems to grow daily in the public mind that they are always thoroughly essential to the welfare of infantile stomachs.

I do not wish for one moment to condemn these preparations as useless, but being often too expensive for the lower classes to buy, the latter generally use a bad substitute as gruel, bread or biscuit sop.

According to my daily experience, most mothers among the poor go out to work of some shape or other, consequently the care of the home and the babies is generally left to other persons, often young children.

In some instances the babies are taken to a *crèche* or infant nursery, where of course they must be fed by hand. It is far from my intention to speak against such useful institutions, but I think their utility should be limited to the infants of widows or women with sick husbands; such is, however, not always the case.

When infants are fed it is generally with bread or biscuit sop, in fact with some farinaceous preparation they cannot digest.

This is often given from the birth, and cannot then be digested owing to the absence of the salivary and pancreatic secretions, which are required for the necessary conversion of the starch contained in farinaceous food into dextrine and grape sugar, previous to its absorption into the system. I will quote from

Dr. Eustace Smith, a great authority upon the diseases of children.

In his excellent work on the wasting diseases of children, he states, that the salivary secretion in the child is not fully established until the fourth month.

He also refers to the experiments of Professor Korowin, of St. Petersburg, which show the secretion of the pancreatic gland in the second month of life to be very scanty, and to have little action upon starch.

The undigested food in the bowels of the infant sets up acid indigestion, and causes a disagreement of the whole alimentary canal.

By its irritation it acts reflexly upon the brain, and often brings on convulsions, one of the many diseases by which infant life is lost.

And that is not the only evil; in addition, the baby is more or less starved.

The food being undigested, its nutritive properties are not assimilated and the system derives no support from it.

I think it cannot be too strongly insisted upon that every mother should suckle her infant and not feed it at all for the first nine months, unless medical advice has urged a contrary course.

I admit that there are many cases where a mother would do well to abstain from suckling her child, but it should always be only under medical advice; and if this rule was always carried out, I am sure the lives of many infants would be spared.

Now many women, either from ignorance of the harm they are doing, or from a wish to be spared a further increase in their family, suckle their children too long, sometimes until the babies are fifteen and eighteen months, or even two years old.

The first effect of this unnatural prolongation is that the mother loses her health and strength, which causes her milk to become thin and poor, showing a deficiency of casein and butter, its nutritive properties.

Then the child in its turn suffers, becoming also emaciated and weak; from a fat healthy looking baby with firm flesh it soon dwindles away to a thin, haggard, flabby pigmy, in fact it is half starved. In this state it is strongly predisposed to catch any of the common ailments of children, as measles, scarlatina, whooping cough, and the like.

The ordinary dentition troubles are also greatly increased, and very often infants in such a condition ultimately die from one of these complaints.

Hence I maintain that the annual reports of the Registrar-General, in which the causes of death are classed under five heads—"zymotic, constitutional, local, developmental, and violent," are in a certain measure misleading; for if the infants were not greatly reduced in strength and almost at death's door from scanty or improper nourishment, they would not so frequently succumb to those diseases, which in the upper classes do not make such fearful ravages.

It is often my lot to see such children apparently waiting for some disease to come and carry them off. I have always found it

a most difficult task to persuade mothers that breast-milk after the ninth month is improper nourishment for their infant. On the contrary, they seem to think that the more weak and ill an infant is, the greater necessity for strict adherence to breast-milk only.

Even when the mothers themselves are ill, they cannot be brought to see that their milk must suffer in quality and quantity, although they would not buy milk drawn from a diseased cow.

I can only hope that this state of ignorance amongst mothers, which is the chief cause of the evils to which I have referred, may be remedied in the future by means of suitable education, which subject I must leave in the hands of other and more competent men than myself. Then and then only will the rate of mortality of infants be sensibly reduced, and the ravages of the zymotic diseases much decreased.

Cause 2nd.—Want of medical assistance at childbirth and during the lying-in state.

This is a minor one in comparison with the first, but still it has some effect on infant mortality.

Owing to the small earnings of the agricultural and other labourers of this town, the high rents and dearness of provision on the one hand, and on the other to the rules of the Local Government Board, or the way in which they are applied by the relieving officers, many of the wives of our poorest inhabitants are without medical attendance in childbirth.

At that critical time they receive only the assistance of some unskilled woman—a laundress, charwoman, or monthly nurse of a low type.

As far as I know, there is only one certified midwife in this large town, and many of the women who attend confinements are dirty and ignorant in the extreme; in fact, I can confidently state that the stock on a farm and the mares in a stable often receive more skilled attention than some of our poverty-stricken fellow-creatures.

The way in which this want of proper assistance affects the mortality rate is as follows:—

The function of respiration is sometimes not properly instituted, owing to the lungs not being thoroughly inflated with air immediately after birth takes place, and the infant dies after a few days of collapse of the lungs, to which disease is perhaps added a low form of inflammation induced by the same.

Feeding with farinaceous or other thin improper food is constantly recommended by the so-called midwives, and has been shown to be a fruitful source of loss of life. But deficiency of suitable clothing is still more often a cause of disease (as far as I have seen, the same amount is given to the infant in all seasons of the year). This want of sufficient warm clothing acts most prejudicially upon those infants which, having been born prematurely, are very thin and wanting in vital power. Low temperature causes them great suffering, and they are often quietly allowed to die by parents imbued with the prejudice that a seventh or eighth month child cannot be reared.

Cause 3rd—Is failure of coroners to hold inquiries and take medical evidence in every case of death occurring to infants which have not been attended by a medical man. That such is the case I need bring no evidence to prove, it is a well-known fact.

I remember well a case occurring in this town, when an infant was suckled one morning at three o'clock, and found dead three hours later at the mother's side. The child had not been ill, in fact was strong enough to draw the milk from its mother's breast.

An inquest was certainly held in this particular case, but no medical evidence called nor a *post mortem* examination made.

I do not wish even to hint that the child was poisoned, but if it had been dosed with paregoric, which contains opium, no one would have been any the wiser.

I believe that the dread of an inquest and *post mortem* examination has a salutary effect upon people who are careless of the lives of infants, or wish to get rid of them for the sake of gain.

That such an unnatural desire sometimes exists, the police reports can amply testify.

Cases have occurred in my experience, when I have suspected a desire for the death of the sick infant to whom I have been called in, apparently at the last moment, for the sake of procuring a death-certificate. On such occasions I always threaten a refusal to certify and hint at the necessity of an inquest, the result being more than once a speedy recovery of the child to health. Whether the failure of the coroners to hold an inquest and call medical evidence upon every certified death arises from a wish to save themselves trouble or the county rates a few pounds, I do not pretend to say; but I maintain that the present uncertainty of the coroners' action robs us of that salutary fear which would tend to make evil-disposed persons very careful of taking away the lives of their offspring or of children intrusted to their care.

In conclusion, I trust that the account given of the three causes which, in my opinion, help to increase the rate of infant mortality, has proved sufficiently interesting to you, to justify me in taking up your valuable time.

F. Nichols.

On Common Lodging-House Accommodation.

If there be a single individual in whose well-being all concerned in the maintenance of public health should take a special interest, it is the poor traveller. Nor is this unrecognized. So long ago as 1848 the State realized that to neglect the poor traveller and his environment was to imperil the health of the community; and

accordingly in the Act for Promoting the Public Health, passed in that year, local boards were required to register common lodging-houses and to make bye-laws fixing the number of lodgers that may be received, for promoting cleanliness and ventilation, and with respect to inspection. Again, in 1851, it appeared to the Legislature that "it would tend greatly to the comfort and welfare of many of Her Majesty's poorer subjects, if provision were made for the well-ordering of common lodging-houses," and the Act of 1851 was passed. But except that it empowered local authorities to make bye-laws in the interests of morality,* as well as health, little was effected by this measure. After some experience of the working of these provisions, it must have been found that lodging-houses and their keepers were still not quite what it was desired to have them, and in 1853 common lodging-honses were once more the subject of a special Act. It was now required that every common lodging-house be "inspected and approved for that purpose by some officer appointed in that behalf;" and permission was given to the local authority to "refuse to register as the keeper of a common lodging-house a person who does not produce a certificate of character," signed by three inhabitant householders. By the Act of 1851 a keeper was required to advise his authority when a lodger became ill with an infectious disease, but by the amending Act the authority was for the first time empowered to remove such lodger, and disinfect or destroy any bedding or clothes used by him. The Acts passed in 1853 also required the keeper of a common lodging-house to thoroughly cleanse it in accordance with any regulations or bye-laws of the local authority, and to the like satisfaction limewash the walls and ceilings thereof in the first week of April and October in every year.

Section 35 of the Sanitary Act, 1866, contains provisions by which a Secretary of State may on the application of nuisance authorities empower them to make regulations as to lodging-houses, but the section does not apply to common lodging-houses.

The Public Health Act, 1848, is now repealed, and so are the two Common Lodging Houses Acts, except so far as relates to the Metropolitan Police District, but the fourteen clauses referring to common lodging-houses in the Public Health Act, 1875, scarcely do more than re-enact the old provisions. However, under this Act the local authority's officer has freer access, and every keeper is required to mark his premises in some conspicuous place outside as a registered common lodging-house.

And now let us see how these arrangements for registration and regulation work. The regulations adopted in most districts have been probably in accordance with those issued under the authority of the Secretary of State. Even since the repeal of the Common Lodging Houses Acts, the old regulations so long regarded as models have still held their ground. These, however, as anyone who has

* The words used are—"for the well-ordering of such houses, and for the separation of the sexes therein."

had experience in the matter will admit, are insufficient to accomplish the object sought. For example, take the following extract from Regulation 8—" The blankets, rugs, or covers used in such lodging-house shall be thoroughly cleansed at least four times every year, that is to say, at least once some time during the first week of each of the several months of March, June, September, and December." Is this sufficient for cleanliness ? Or take Regulation 11, in which the existence of lodging-houses without yards is clearly recognized, and two or more houses uniting to provide a single "convenience" is sanctioned. I would draw attention also to Regulation 12, requiring that—" The sink in the yard shall be so placed as to take all waste water through the drain from the closets," which is certainly not an arrangement to be commended. There is nothing to be gained by criticizing further these regulations, more especially as they now have no official authority ; yet I believe that the regulations this day hung up in most common lodging-houses are little, if at all, in advance of the models.

And what is the result ? I will tell you.

The poor traveller arrives in a town, and goes in quest of lodgings. He is a decent man, and particular that the house he selects shall be a registered one, as he thinks this gives him some guarantee that his quarters shall be clean, airy, quiet, and well-ordered. He pays his fourpence, and is admitted by the " deputy," who represents the only authority in the building, the actual proprietor being a publican, an eating-house keeper, or marine-store dealer—that is non-resident. The room that he is shown into (the only one in the house not a bedroom) is already more than sufficiently full with men, women, and children. One lodger is frying tripe, another toasting herrings, two or three are drinking and smoking or singing, while in a corner, it may be, a woman is busy washing clothes. Unless the new arrival is willing to join in the drinking and singing, and pay for a share of the beer, a seat is only found for him grudgingly. In any case, he can scarce stay long in this room without getting a headache ; so he leaves the convivial party, and goes to bed. But up with him, too, comes the steam from the washing-tub, and the tobacco-smoke, and the smell of many savoury suppers. The wooden bedstead is old and infirm, and the tick upon it is filled with flocks hard with much lying on, and the covering is a folded blanket. Bedstead, bed, and bedclothes are all dirty, and with a sigh the poor traveller prepares for his night's experience. Taking a look round, he notices the entire furniture of the room consists of three bedsteads, an iron bucket, and a line stretched across from wall to wall, on which he hangs such of his clothes as he divests himself of. The fustiness of his surroundings, the noise and fumes from downstairs, combine to keep the poor traveller awake till the revellers join him. Two turn in to each of the other beds, and his bedfellow, not steady enough, it may be, to attempt undressing, lies down, boots and all. What is the poor traveller to do ? He is too hot in summer, too cold in winter. He wants a draught of water—he cannot have it. He wants to bathe his face—he cannot

do it. In superlative discomfort he keeps his vigil, perhaps till early dawn, when

> "Wearied out, he sinks to sleep,
> To sleep, but not to rest."

This is no mere fancy picture. I have never played the part of an amateur common lodger, but I have visited many registered houses in the daytime, in the evening, and in the early morning hours, and I describe to you what I have seen. I ask you now, as I have often asked myself, is the poor traveller fairly dealt with? We pretend to take a special interest in him, and see that he is provided with a clean bed, sufficient breathing space, and a tidy room in a well-ordered house, and we stamp the room and house with our official stamp to show that we are really in earnest. He respects the Sanitary Authority, and learns too late that it sanctions dens of dirt and overcrowding and impure air.

What has been and is required as regards common lodging-houses is the repression of overcrowding, and securing cleanliness, sufficient ventilation, and decency. To obtain this, two things are necessary—(1) a well-considered set of regulations; and (2) due provision for systematic inspection. The second is at least of equal importance with the first. A well-ordered common lodging-house is then perfectly practicable? Undoubtedly in large urban centres it is. Nay, more—in Glasgow, Liverpool, Manchester, Birmingham, Bristol, &c., it is an accomplished fact. The difficulty I am speaking of does not arise in large cities and boroughs where the accommodation required is on a large scale and readily afforded by private enterprise, and where inspection is systematic and in the hands of properly trained inspectors. It is not of the great populous centres the poor traveller has reason to complain, but of urban districts where precisely the opposite conditions obtain, where it will pay no one to open a big house as common lodgings, because the sum of the beds there is a demand for is so small, where there is no systematic inspection, no night inspector, no security as regards the separation of the sexes. The local authority I serve, I regret to say, is much in this position. We have but eight common lodging-houses on our register, all situated in the same neighbourhood (five being in the same street), and all being poor, squalid little dwellings. The sum of the beds registered is forty-eight.

What is to be done by towns thus circumstanced? It is a perfectly hopeless task attempting to reform the existing common lodging-houses; the one course which promises satisfactory results is for the authority itself to provide the requisite accommodation. This, however, the Sanitary Authority has no power to do. It may provide public baths, washhouses, open bathing-places, infectious diseases hospitals, disinfecting houses, patients' conveyances, vans for the transfer of clothes, and mortuaries. Why may not urban authorities provide common lodging-houses? It is surely of as great importance to a town that its poor shall be wholesomely lodged as that they shall have facilities for washing themselves and their clothes. The Public Health Act should surely have given us

this power, and when the opportunity occurs, steps should be taken for securing it. Even if reform of the wretched hovels called common lodging-houses, as they exist in most small towns, were possible, it could not be accomplished at a less cost than the provision of lodgings which should be absolutely perfect. In ordinary cases I would not advocate the erection of a special building, but the hiring of a pair of suitable houses—one for male and the other for female lodgers. A man and wife could be put in as caretakers, and these being the servants of the Sanitary Authority would of course act as night inspectors. Each house should have a sitting-room, kitchen, and wash-house, and the bedrooms should be furnished with small iron bedsteads. The ventilation should be automatic, and independent of the opening and shutting of windows.

I shall not go further into details, but I think you will see that the plan is quite feasible if only the Sanitary Authority had the necessary powers. Such an establishment as I propose could never be overcrowded, there would be no double beds in it, and it would be at all times cleanly, tidy, airy, decent, and well-ordered. As for the keepers of the old lodgings, they would soon find their occupation gone, and in course of time the houses would be put to some other uses.

I trust that what I have said may have succeeded in awakening sympathy for the poor traveller, and drawing attention to some of the circumstances of his surroundings. Each individual has a personal interest in giving this matter his earnest consideration, for the baneful effects of neglecting common lodging-houses are not restricted to their occupants.

F. VACHER, *Medical Officer of Health for Birkenhead.*

The Influence of Efficient Sanitation in the Prevention of the Himalayan Plague.

The plague of Egypt finds a congenial soil in the Himalayahs; and India has been described as the home of cholera.* On a future occasion I hope to give a detailed description of the former disease as it occurs in the Himalayan valleys; the present account pretends to nothing beyond a mere sketch. The Himalayan plague, known locally as *Mahamurree*,† was first noticed by a Europan traveller in 1823. But it attracted no special attention till 1850-51, when the inhabitants, inspired by terror of the enemy, whose visitations were periodically becoming more frequent and virulent, began to flee the country in such large numbers that the Indian Government unable, in consequence of this wholesale exodus, to collect the

* Macpherson's "Cholera in its Home."

† From *maha*, great, and *murree*, disease.

usual revenues, instituted an inquiry. The administrative medical officer of the district, and a junior surgeon on duty in the Hills, from which he was temporarily detached, were deputed to make investigations. Both agreed that the disease was a low fever of the most active type, aggravated and fostered, though, doubtless, not caused, by the filthy habits of the people and their unwholesome surroundings. It fell to my lot to be subsequently associated with the surgeon above referred to—Dr. Francis Pearson—in a special organized inquiry into the whole subject—an inquiry which extended over two years. We both unhesitatingly came to the conclusion, after observation of several cases, that *Mahamurree* was identical with the veritable plague.* There was the low prostrating fever running a remarkably rapid course, accompanied *occasionally* by hœmorrhages, vibices, and petechiæ, *always* (where there was time for their development) by buboes in the groin, or other glandular swellings; and the disease was highly contagious. The fifth, in all but the speedily fatal cases, was the critical day. If the eighth was reached, the patient, as a rule, was safe .Suppuration of the inflamed glands was a favourable sign. To promote it the natives would thrust in a red-hot packing needle. Profuse perspiration was also a good omen. These happy events would occur, if at all, between the above-mentioned days.

A remarkable feature in connection with an outbreak of *Mahamurree* was the death, in the first instance, of the rats.† A rat would emerge from his hole, and walk along the floor of the apartment as if intoxicated; then, performing a gyration or two, he would bring up some blood, and die. A *post mortem* examination revealed a perfectly healthy state of all the organs *except in the lungs*, through which were distributed small black carbonaceous looking patches—little islands of hœmorrhage, in fact. As in the Himalayan villages the rats were invariably first attacked, their fate might have served as a warning.‡ If the human inhabitants had accepted it, and gone for a time into the adjoining woods, all might have been well. But, instead, they would linger on until one of themselves would become a victim. Then, they would flee in all directions; the ties of kindred being in many cases quite lost sight of. Husband and wife would separate from each other; parents would leave their children; and the saying of a man shunning his neighbour "as if he had the plague," was here illustrated in all its grim reality.

Then, the bears would come and hold high revels in the deserted villages: and granaries of grain, stored for the next winter, would be consumed in a few hours.

Remedial measures were of little or no avail. In some cases

* This is Pettenkofer's opinion.

† This feature has also been observed in Syria, &c. The fact seems to point to the special virulence of the poison.

‡ In some plague stricken villages at the foot of the Himalayahs the rats were not the first victims.

death would supervene so rapidly that there was no time for medicine to act. In those that ran their course of five days and upwards, there was no arrest nor diminution under treatment of the symptoms. The vast amount of general internal congestion that was revealed at the single *post mortem* examination that we had an opportunity of making, indicated the necessity for remedies to relieve this condition, and to equalize the circulation. Calomel, however—the best of these remedies—was a hazardous drug to prescribe in so prostrating a disease; and the results obtained from large doses of quinine and other febrifuges were not altogether satisfactory. Two or three individuals did indeed recover, but it is questionable if we cured them. Even in the cases most favourable for treatment, they were not seen early in the attack. We furnished the villagers, through their head men, with supplies of medicines, and pointed out how certain indigenous plants might, in the absence of these medicines, be utilized; but it was evident that the best measure of all was *prevention.* Living, as each family did, in a small, almost hermetically sealed, overcrowded hut of two compartments, the lower being occupied by the cattle and the upper by the family—I once counted thirteen in one—all available spaces being taken up by the baskets of grain, and the solitary hole in the wall, which served the purpose of both chimney and window, being carefully stuffed with straw; and the surroundings being composed of ancestral heaps of manure, with vegetation flourishing and *decaying* upon them; and hemp and other growths, rising to a height of from 8 ft. to 12 ft., and impeding the circulation of air about the little village; these were conditions calling loudly for the Sanitary reformer.

Upon the recommendation of the medical authorities, Sanitary measures were under the superintendence of the magistrate—(it was found advisable eventually to invest Dr. Pearson, who, at the close of the inquiry, remained as a special *Mahamurree* officer, and superintendent of vaccination, with magisterial powers)—actively carried out; and, in consequence, the plague in those hills, which used to show itself biennially and triennially or even annually, has been practically extinct for the past twenty-five years. During this period the disease has once or twice threatened to become epidemic; but it was discovered that a temporary relaxation of the Sanitary regulations had led to this result. It is now, however, generally admitted, even by those who are lukewarm in the cause of sanitation, or see no good in it, that here, at any rate, it has been of decided benefit. Such persons have admitted that it is altogether a "neat case."

It is satisfactory to know that the risk of infection from *Mahamurree* is (such, at least, is the well-founded belief) limited, as a rule, to the villagers themselves. The disease is epidemic only where it is *endemic.* No pilgrims—sometimes a numerous body—('tis true that they would naturally give infected villages a wide berth) have ever, any more than ordinary travellers, been attacked by it as they journeyed from their homes in the plains to the

mountain shrines of Gungotri,* Jumnotri, Budrenath, &c. Nor did we ourselves nor any of our native followers suffer.

Mahamurree appears in a plague latitude ; and, though probably of telluric origin, finds its home in a combination of suitable surroundings, such as would hardly be met with in any other latitude. The higher temperature of the *plains* of India, combined with the personal cleanliness of the people (the hill native of Gurhwal, where *Mahamurree* is especially rife, rarely washes, and his *woollen* clothing is worn till it drops off !) are opposed to the *descent* of the disease in that direction. Simultaneously, with outbreaks in the hills, the disease has indeed appeared in two adjoining villages in the districts immediately below, but the cause has in each case been traced to contagion. In these villages the *rats died after the people were attacked.*

The plague, due to importation, also appeared some fifty years ago on the western coast of India—under the name of the *Pali* ; but its area was limited. These instances of plague appearing in the plains of India show the *possibility* of its extension into them ; a fact which, in addition to other obvious reasons, quite justifies the Indian Government in maintaining a separate medical officer to carry out Sanitary legislation in the Himalayahs.

C. R. FRANCIS, *late Surgeon-General Indian Army.*

The Unhealthiness of Public Institutions.

THE unhealthiness of public institutions is becoming more and more an admitted fact. Hospitals, asylums, schools—to say nothing of convents, refuges, and homes under private management—have of late all shown signs of unhealthiness, which should not exist in such institutions, notwithstanding that people say that sickness exists everywhere, and must therefore be necessarily found in all public institutions ! Is this so ? We doubt this postulate, and for the following reason :—Since the prisons of this country have come under the control of Government, they have gradually been made probably the healthiest residences in the United Kingdom. Dr. Gover, the Medical Inspector of Prisons, in his "Notes," attached to the Second Report of the Prison Commissioners, gives incontrovertible evidence of the truth of this fact. He proves that in all the prisons of England and Wales, during one entire year, only one case of small-pox, and not a single case of scarlet or typhus or gaol fever occurred. What a contrast to the old days when gaol fever was so alarmingly fatal to prisoners, judges, juries,

* Sacred Hindoo shrines in the snowy regions, bordering on the Thibetan plateau.

and indeed to all who had business at the criminal courts, that history too often marks its ravages in certain towns by recording there a black assize. Again, only fourteen cases of typhoid fever are reported by Dr. Gover, five of which occurred in one prison, in an infected district. In the majority of the prisons there was not a single case of typhoid fever throughout the year. In the fourteen cases reported, the origin of the disease was invariably traced to Sanitary defects, which were proved to have been in existence before the Government had control of these establishments. It is, therefore, reasonable to hope, that during the present year typhoid fever will also be banished from all the prisons. Why should such a desirable guarantee of health be confined to the occupants of prisons? Before giving the reasons for this startling anomaly, it may be well to state that only typical and published proofs of the unhealthiness of the great majority of public institutions and its causes will be given in this paper. A departure from this rule would necessitate an abuse of confidence which would be neither politic nor just. Again, no detailed remedy will be suggested, because the necessities of each institution will require separate consideration, and, probably, distinct treatment.

Having said so much by way of preface, to obviate misunderstanding, I proceed to ask why, in the face of the facts stated by Dr. Gover, do the authorities of other public institutions look upon the presence of a certain number of cases of zymotic disease as unavoidable? They must believe this to be a sound position, or it would not be possible to record such cases as the following:—The Manchester Infirmary, one of the oldest, largest, aud most important of provincial hospitals, was, less than three years ago, declared, by Mr. Netten Radcliffe, to be "unhealthy from cellar to garret."* Its Sanitary condition is bad. Yet the authorities of this institution had been warned, over and over again, during a series of years, by outbreaks of pyæmia, erysipelas, and other traumatic affections, that something must be wrong. But, some one may say, why should such outbreaks be taken as showing the insanitary condition of a building? I answer, sewer gas has been proved to be a prolific cause of erysipelas, and it is now shown to cause much pyæmia in hospitals. I will not now give evidence of the truth of the former statement. I have never heard it contradicted. But of sewer gas as a cause of pyæmia, I would say that the following instance seems to prove the case beyond dispute. Pyæmia occurred in the chief surgical ward of a large hospital three years ago. This ward was built upon the pavilion principle, and was quite separate from all the other hospital buildings. Some thirty patients were affected in a few weeks, and so violent was the outbreak, that the surgeons declined to operate. At that time the sewers were unventilated, and all soil pipes were in direct communication with the sewer. No sooner, however, were these defects remedied, than pyæmia entirely disappeared. No other cases of pyæmia occurred for six months, when, all of a sudden, the disease

* *Sanitary Record,* Vol. x. p. 371.

again appeared in a virulent form. As it continued, the ventilating shafts from the soil pipes were examined carefully, and it was discovered that they were stopped up. Some workmen had been engaged on the roof, and as they objected to the smell from the ventilators, they had closed them with pieces of rag. This is a proof of the necessity of a regular inspection of all ventilating shafts, open soil pipes, &c., &c. Of course, the ventilators were at once put into working order. Since then, during two whole years, the disease has almost disappeared from the hospital. In this connection it is fair to give expression to the conviction, which is founded upon observations during many years' residence in a hospital, that had not Mr. Lister introduced the antiseptic system of dressings, several of the older hospitals must have been closed long ago.

Now, it has been shown that one of the oldest and most important of provincial infirmaries proved on investigation to be unhealthy from cellar to garret. It has further been shown that sewer-gas is a prolific cause of pyæmia and erysipelas. It remains to connect cause and effect. On examination and inquiry it was found that no one connected with the management of the Manchester Infirmary could give Mr. Radcliffe, the Government Inspector, any reliable information as to the drainage arrangements of the building. In fact, excavations had to be made here and there to ascertain the exact condition of drainage affairs. Alarming and astonishing as this statement may appear, its effect will be increased a hundredfold by the declaration, that investigation has brought to light, that not ten, and possibly not five per cent. of all the hospitals throughout Great Britain and Ireland possess any *reliable* plan of their drainage arrangements. Even some of the most important hospitals in the kingdom have no such plans, and it would be easy to give instance after instance of the culpable ignorance which prevails on this important subject. What then is the probable condition of the drains of an institution built, it may be, fifty years ago? Remembering the action of sewer-gas upon hospital patients, and considering the only answer that can be given to this question, is it much use fighting about the comparative healthiness of different medical charities until so crying an evil is redressed? For my own part, I have no doubt that hospitals where the antiseptic system is enforced can be made as healthy as the prisons to which reference has already been made. Hospitals belong to a class of institutions which ought to be specially provided with adequate Sanitary arrangements. The unhealthiness of such institutions is a serious matter, because it not only places in jeopardy the reputation of the medical staff, but the lives of many thousands of the people. It cannot, therefore, be doubted that if the attention of the committees of these institutions is once aroused to the importance of having an adequate system of drainage, a remedy will speedily be forthcoming.

Turning now to the health arrangements of the large lunatic asylums of this country, a fair insight may be gained into their condition by recalling the evidence recently given at Frome before the

Somersetshire coroner.* From this evidence it appears that from December, 1878, to May, 1879, thirty-two cases of spontaneous erysipelas occurred among the inmates of the County Lunatic Asylum. Of these, twenty-three cases broke out in the female infirmary ward, and nine on the male side. Of the whole number nine died. At the time of this outbreak complaints of ill-health were made by very many other patients. Nausea, headache, sore throat, and general *malaise* were long prevalent, and these symptoms were followed by an epidemic of diarrhœa. Bad smells were noticed in all parts of the building, and it soon became evident that sewer-gas was almost everywhere present throughout the asylum. The medical superintendent, Dr. Medlicott, had his suspicions aroused, and a thorough overhauling of the drainage arrangements took place. These investigations disclosed the following instructive facts. None of the soil-pipes were ventilated. Most of them were of lead, and several were rat-eaten, and riddled with holes. On taking out the pan and syphon of the infirmary water-closet, a hole in the soil-pipe, 3 in. by $1\frac{1}{2}$ in, was discovered. This soil-pipe communicated directly with the main sewer. The main drain outside the infirmary ward, where two-thirds of the erysipelas cases occurred, had been choked more than once during the year, on one occasion to the extent of from three to four yards. In consequence of an insufficient fall the main drain had been stopped several times. Thus, it is clear that for months, and probably in an increasing degree for years, the inmates of this County Lunatic Asylum had been subjected to the influence of gases, generated by fermenting sewage, which were constantly brought to the interior of all parts of the institution by the unventilated soil-pipes, from which poisonous vapours were admitted within the buildings, through the rat-holes above described. No wonder the jury declared that the erysipelas was proved to be due to an escape of sewer-gas, owing to the insecure and insanitary drainage arrangements. How many lunatic asylums in different parts of the country are liable to a similar outbreak of erysipelas for like reasons?

Uppingham Grammar School is a typical instance of the dangers arising from defective drainage at the public schools. The experience at this school was sharp and decisive, and it has tended to arouse the authorities of several other large schools to active exertion. But who can say how many masters and governors of semi-public schools and colleges are ignorant of the present state of their drainage systems? If we include private schools, the Sanitary condition of the buildings used as school-houses must often be terribly deficient.

I have not the space to give my experience of the hygienic (?) surroundings of convents, refuges, homes, and other like charities. I shall, therefore, content myself with the observation that the conclusions I am forced to draw from investigations I have been making in Dublin during the past few weeks, strengthen the conviction I

* *Sanitary Record*, Vol. x., p. 357.

had already formed on the subject. This conviction is, that if the unfortunate inmates of these religious and charitable institutions often suffer cruel hardships at the hands of those who have charge of their management, the Sanitary arrangements, for the most part, of such buildings, must render residence within their walls highly dangerous to health.

Finally, I do not think it is too strong a statement to say that the probabilities are decidedly against there being one in ten of such institutions, that would stand an impartial investigation into its drainage arrangements without producing as startling revelations, as those made at Manchester and Frome.

The facts I have here given—facts selected from a number of instances I have collected during the past few years—abundantly bear out the assertions of Dr. Buchanan. Speaking of improper connections between sewers and buildings, he declares that in this way the air of sewers is laid on to the houses. The larger the house, the greater is the danger, as, unless the drainage and plumbers' work have been executed in the most perfect manner, every bath, every lavatory, every sink, and every waste-pipe is an additional danger. How fully the experience of the Somerset County Asylum bears out the truth of Dr. Buchanan's words! What, then, is to be done? Is it longer to be tolerated that the lives of many innocent persons, who, from being placed in these public institutions, are powerless to help themselves, shall be annually sacrificed because no adequate drainage arrangements exist in the majority of such buildings? The answer to such a question cannot be uncertain. The moral is plain to read, but difficult yet to apply: First, let every responsible person who is connected with any public institution take the facts here adduced to heart. Let every committee, or council, or board of governors at the next meeting, ask for a plan of the drainage arrangements of the hospital, or asylum, or school in their charge. If this is forthcoming, let there be no loss of time *in testing its accuracy*, and, under any circumstances, let them procure a report from a competent expert of the exact Sanitary condition of all the buildings in their charge. In this way the truth can alone be ascertained. If the authorities longer neglect so plain a duty, it will not be unreasonable for a jury to bring in a verdict of manslaughter should any deaths be produced in future by sewer-gas, from causes similar to those exposed at the County Asylum at Frome. With the report of Dr. Gover before them, the managers of all public institutions ought to take courage, because such a report shows that preventive medicine is a great fact. Experience has now proved that sometimes science can point to such unanswerable evidence with the proud assertion, prevention is better than cure. It is a scandal that the insanitary condition of so many private houses is the origin of so much avoidable disease. It is a disgrace that any public institution should be without a reliable plan of its drainage, or a perfect system of hygiene. How much longer is it to be possible to declare that if a man is really anxious to guarantee to himself six months' perfect immunity from preventable disease, he must get committed to one of Her Majesty's

prisons? And why? Because private houses and public institutions are not free from preventable impurities, whilst lodgings, and even hospitals, are too often, compared with prisons, highly dangerous abodes for any one who has a tendency to zymotic disease. In Ireland most of the public institutions are in part supported by Government grants. In England and Scotland this is seldom the case. Still, Government grant, or no Government grant, adequate Sanitary precautions ought to be taken at all public institutions to protect the lives of the inmates. No permanent reform is likely to be enforced without a thorough, an independent, and a periodical inspection of all the structural and drainage arrangements of these buildings. It would, therefore, be a great public gain if a Special Sanitary Inspector could be appointed, whose whole time should be devoted to the inspection of the Sanitary arrangements of public institutions, good, bad, and indifferent. Will the Congress support this view by resolution? Such a recommendation to the Local Government Board would not be invidious; because the managers of these institutions are becoming more and more alive to the Sanitary difficulties which have to be overcome. Hence, the institutions would willingly welcome the help, and follow the guidance of such an expert. The managers of these institutions pay handsomely for a periodical inspection of the boilers and machinery in these buildings, because they appreciate its value. The Sanitary Inspector would be more welcome still, because he would not only reduce expenditure, but he would increase the health of all the inmates. At any rate, the compulsory registration of the plans of all public or semi-public buildings is a much needed reform.

HENRY C. BURDETT.

Nurses: How to Make them, How to Use them, How to Pay them.

THE propriety of reading a paper on Nursing at a Sanitary Congress will be pointed out more particularly at the close of this paper. At this stage I will only say that the President of this Congress, on hearing accidently from me what had been done in Derby during the last fourteen years in connection with our "Nursing and Sanitary Association," said, "You should bring the question forward at Croydon; Dr. Carpenter's section on Sanitary Science and Preventive Medicine will give you a hearing." As Miss Nightingale well says, probationers must be sober, honest, truthful, trustworthy, punctual, quiet and orderly, cleanly and neat. patient, cheerful, and kindly, and to these qualifications let me add that they should be Christians with a single eye.

And where, it will be asked, shall we look for such? I answer,

Expect to find them everywhere. There are more women of this kind than people commonly suppose. They are not met with easily, perhaps, but that is very much because such people are commonly retiring and unobtrusive. They have something in them of the nature of the sensitive-plant, but there are such people in the world, and the way to get them is to let them know that they are wanted. Let the public see to it that openings are made for them. In other words, let the demand be for this kind of women and the supply will, in obedience to the rule, be forthcoming. They will come quietly, dropping in one by one, and the kind of women that you will get in any one locality will depend very much upon the atmosphere—that is, the nursing atmosphere of the neighbourhood—the training that you give them—the way you use them—pay them—treat them after they are trained, and, last not least, the kind of house you provide for them. At present at least Homes are necessary, and the house will depend upon the lady who has charge of it.

I will not further anticipate what is to follow, but proceed at once to consider more definitely how to make these women into nurses. There are exceptions to every rule, but, in all ordinary cases, nurses must be made in public hospitals. To this special use of hospitals the attention of the public requires to be directed; the public should take more care than it has done that every hospital in the kingdom is used more or less as a school for nurses. Certain large hospitals in the metropolis, and a few in the provinces, have long been recognized as useful and nece sary for the education of medical men; and if the students are under proper surveillance the hospitals are improved by being turned to this account. In like manner, only to a larger extent (for there should to this be no exception), hospitals should be schools for nurses; and if the nurses are placed under proper direction, the hospitals will be improved thereby. The question as to the regulations under which these women should be admitted must be dealt with cautiously. So far, however, as I have observed, it is not necessary for the hospital to do more than to provide proper accommodation for these women, and to take care that the nursing is under the direction of a qualified lady. This lady should have unfettered liberty in the choice of her staff and of the pupils (or probationers. as they are called), for upon her must rest the main responsibility of the service. I think also that the lady superintendent should invariably be responsible, not to any outside authority, but to the general board of management. Let these simple points in all their fulness be admitted—that a hospital is not doing its duty properly if it is not training nurses; that in order to train nurses there must be some one person responsible for the selection of such women as I have named, and duly qualified to give them instruction; and thirdly, that this person should be, like every member of the staff, under the control of the general board of management. Then, for all practical purposes the question is answered—How to make nurses.

I pass on to the second point, How to use them? This second question may be answered by one word—use them *well*. Don't pet

them, but take good care of them; use them as servants, but remember that their service is special, and use them for that and not for other kinds of service. Do not, for instance, in a hospital let the nurses scrub the floors or clean the grates. I know that in some institutions this menial service is required of the probationers as part of their training! I hold it to be a mistake to set even probationers to scrub floors. Let me not be misunderstood. I would not have a nurse refuse, under exceptional circumstances, either to wash a floor or to clean a grate, but the circumstances must be very exceptional. Again, use them well by providing that they shall have good food, and proper time for rest and relaxation. It is false economy—to take no higher view of the question—to overwork a nurse. I plead not for luxury, but I plead for that which experience proves cannot safely be left to chance either in hospitals or in private families. Use your nurses well, treat them with confidence, take care of their health, be careful that they have a sufficient amount of sleep and fresh air, beware above all things of giving them stimulants "to keep up their strength," and do not expect from them that which is unreasonable. It will scarcely be believed, but I have known a person think that a nurse, because trained, would be able to stay on duty night and day. When she was remonstrated with, this ignoramus replied, "I thought that she was a trained nurse."!!

But even where employers require nothing so unreasonable, it is well to remember that nurses themselves—some of the best nurses—will overtax their strength unless we act not only as their employers but as their protectors. I shall have something more to say on the employment of nurses afterwards, when speaking of nursing associations, but I pass on now to the third point: How to pay nurses?

This question, like the last, may be answered by one word, and by the same word—pay them *well*. By this I do not mean pay them extravagantly, at the same time I do mean pay them properly, honestly, and if you will take my advice you will insist upon it that they are paid. You may rely upon it, that there are few exceptions to the rule "that which costs nothing is worth nothing," and before nursing is admitted to be one of these exceptions, I venture to suggest the inquiry, whether those who nurse "for nothing" are not, sooner or later, paid in some other way. At any rate, let me say, that the attempt to divide nursing into paid and unpaid, and to speak of unpaid nursing as if it were necessarily superior to that which is paid for, to throw a reproach upon paid service by using such terms as "mercenary," "hireling," &c., is a great mistake, an injustice, and an expensive fallacy. My advice, then, is pay them. Insist upon paying them properly the full money value of their services; let there be no debts on the one hand; on the other, let there be no indebtedness, except that debt of gratitude which money may acknowledge, but can never pay. I am quite ready to admit that if you treat nurses with confidence and consideration, it will greatly enhance the value of any money payment; but as to the money itself, let it be a plain, straightforward piece of

business. Thus you will see that these questions may be answered in a very plain, common-sense way; and this is precisely the way in which all questions about nursing should be dealt with.

It will serve to test what I have already laid down and to extend your interest in the subject if I make a few more remarks on the employment of nurses. There are three tolerably distinct fields of work in which nurses may be employed in hospitals, in private families, and amongst the poor in their own houses. I do not propose to say anything more on the first two—nursing in hospitals and nursing in private families, but on the employment of "district" nurses amongst the poor a few practical suggestions may be acceptable. And first, just as nurses in a hospital need to be under the direction of a resident lady-superintendent, so district nurses among the poor must be superintended; and further, the superintendence must be by some one who is their superior in position and in knowledge. The lady-superintendent should herself have had training. If the nurse knows more about nursing than her superintendent, you can well imagine that the superintendence will be more a name than a reality. Of course, one person, if specially set apart for that duty, can superintend many nurses, and in a large town this is by far the best plan. She must, as in the case of hospital nursing, choose her own staff, and the same person can very conveniently and effectively take charge of the other nurses who are to be employed in private families. Then the Home for these nurses should be made the residence, and a comfortable one, for the lady-superintendent.

Again, the institution will soon become a valuable centre of all nursing business, a store-house for sick-room appliances, couches, pillows, bath chairs, &c. &c., an invalid kitchen, and the place for getting help of various kinds for convalescents, sending them to the sea, giving them extra food and clothing, encouraging them as much as possible to help themselves. As to the loan of sick-room appliances and the supply of comforts of other kinds from the kitchen, the nurse should simply distribute what the lady-superintendent directs; least of all should the nurse be allowed to give stimulants at her own discretion; indeed, the wants of the sick poor are so many, and of these so many rank in importance before stimulants, that I should myself be quite willing to have stimulants struck off the list altogether. Proper food, bed-rests, couches, air-pillows, clothing and such things will more than consume the supply that the public can be expected to furnish. Stimulants too often mean want of fresh air and want of good nursing. As a general rule, a good nurse and stimulants are at the antipodes, when the one comes in the other goes out, and *vice versâ*. It is in this department of district nursing that the Sanitary aspect of the question becomes so conspicuous. A district nurse going from house to house among the sick poor is a most valuable health-officer, and this leads me to remark that when you come to organize a nursing association you will find it practically of great service to regard it as much as possible as a Sanitary question, rather than for instance an ecclesiastical one. It should be a nursing and Sanitary association.

At Derby, from the first, the object of our association was stated to be "to provide thoroughly educated nurses for the sick both among the poor and in private families, and to organize means which shall tend to the prevention and more or less directly to the removal of disease." This basis has proved itself after fourteen years' trial to be a sound one. It covers all the ground. It enables you to take up as occasion may serve any Sanitary question that arises (without starting a new society). There are many such questions in connection with nursing which cannot be separated from it, for instance, the providing change of air for convalescents and giving of them extra food, and thus materially contributing to the stability of the cure,—nay, more, the feeding of weakly ones, children and old people who want food not physic for many of their ailments. The establishment of cottage-hospitals, and to mention only one more—the latest development of our work in Derby—the delivery of health-lectures.

You have no doubt heard in Croydon of "Ambulance" classes—a term borrowed from military service, but specially adapted to the wants of civilians by the Sovereign and Military Order of St John of Jerusalem. So far as I am aware, in every place except in Derby, these classes have been an importation from that quarter. But in Derby from the commencement we have declined all and every outside authority. We lose something thereby in prestige and patronage, but we gain in freedom and in power of adaptation to circumstances. We require, as I have said, our nurses to have a single eye, our organization in like manner has been "single." In this way you escape both Scylla and Charybdis.

The Apostolic maxim, "Study to be quiet, and to do your own business," will not fail you in nursing, least of all, when it comes into contact with other business, even business more important than itself, I mean of course, when it comes into contact with religion. The so-called religious difficulty may always be satisfactorily and thoroughly disposed of in this way. There need, in fact, be no difficulty; any semblance of one "*solvitur ambulando.*" Go straight forward: bring the question at once to this simple issue, Is it nursing? Is it good for nursing? If it is, adopt it. If not, reject it, and do this at all costs. If it is a doubtful point, leave it open. Religion that will not bear this simple but, let me add, searching test, has something wrong in it; at any rate it will not serve you in nursing the sick. Thus I have endeavoured to answer the three questions proposed about nurses, how to make them, how to use them, how to pay them. In doing so, I have shown that the question is capable of very considerable enlargement. This extension if not forced, but allowed to develop itself naturally, falls strictly within the province of the business of this Congress, and of that particular department to which this section is devoted, "Sanitary Science and Preventive Medicine."

W. OGLE, F.R.C.P., M.D.

Some Remarks on Hereditary Influence.

WHAT will be the future of man (considering him merely in reference to his animal nature)? Whether his body and mind will degenerate, or whether both will rise superior to what they now are, is a question of such intense interest that one wonders it has not more often engaged the attention of philosophers than it has.

Treatises on Education (meaning by education the improvement of the existing generation) are legion; whereas treatises on Heredity are very few. The word has hardly yet been realized in our language, and, perhaps, there are many here present who have never heard it at all.

Now, the definition of Heredity is *the sum of those qualities of body and mind which, being born with us, are transmitted to our children* in contra-distinction to those qualities which are acquired afterwards by self-improvement or education. And as the subject is one about which there is a great deal of vagueness and indistinctness, even amongst the best writers, I will ask your indulgence, while I endeavour, before proceeding further with this paper, to make my meaning clearer by giving some homely instances of it.

Let us suppose a person to be born with a bad temper, but to exercise a self-control and be actuated by a sense of duty that enables him or her to reverse it—then, according to my view, the *unchanged*, not the changed, temper will pass to their children. Or, again, suppose a man to have a bad memory, but to improve it by study and attention to business, I contend that his *unimproved*, not his improved, memory will be transmitted to his offspring.

This theory of Heredity is controverted by many—especially by the advocates of education, who assume that instruction conveyed to children will pass on to their children again, not in the way of precept and example merely, but *naturally*, through the blood. And a very similar doctrine is used by writers on pauperism, and on temperance, and above all by men who adopt the false theory (false, at least, in my opinion) of evolution.

I will not, however, delay you by entering into controversy with them, because, for the purpose of my paper, I assume it to be *an axiom*, that *acquired* habits of individuals, whether human beings or animals, are *not hereditary*. And my object will be to point out certain circumstances which, viewed from this standpoint, seem likely to affect our posterity.

I. The first circumstance I shall name is *the large increase of wealth accruing from trades and manufactures* and the *comparatively small increase arising from agriculture*. The consequence of which state of things is a perpetual flow of population from the rural districts to the great commercial centres of cities and towns.

Now this migration operates in a peculiar manner, inasmuch as by far the larger portion of those who so migrate are women—(a fact, of the truth of which anyone may satisfy himself by turning to the census of the last two decades). And it requires but little

consideration to prove that the women so migrating are among the most attractive—at all events, the ablest, and such as have the greatest capability for work.

If a girl of humble origin is superior either in mental advantages or personal attractions to those who surround her in her native village, the probability is that she aspires to some higher position than that of a labouring man's wife. She becomes an assistant in a shop, or, if of more intellectual tendencies, possibly a schoolmistress. Her time is taken up and her attention engrossed with her duties, and she becomes comparatively old ere she becomes a married woman. Country villages are thus deprived of the best looking, the most healthy and the most efficient of their female population; while the agricultural labourers are of necessity obliged to take less gifted wives, and consequently have less gifted offspring.

II. A similar cause of deterioration and, perhaps, a greater one, inasmuch as it affects a still larger class, is *the celibacy arising from domestic service.*

Maidservants are taken chiefly from rural districts, and selected by their mistresses for efficiency in work, and, in a great degree, because of personal appearance. I do not mean that this last quality is ostensibly put forward as a requirement for service, but it is so practically; for no mistress would receive a *very* plain girl into her household, and certainly none would receive a deformed one. Thus women who might have made the most eligible mothers are taken away in order to be servants; and few of them return to their villages after having become used to a way of living which disinclines them from encountering again the hardships of cottage life. For the most part they remain in service, and consequently single, until an age which renders a family doubtful; while others gain the confidence of their employers, and remain in the servant life till the end of their days.

The evil arising from this is that the agricultural labourer, being restricted in his choice of a partner by the flower of his female surroundings being taken away, is obliged to fall back on the less good residuum. And, as in the case I described before, the race is rendered less efficient in mind and body, and in every sense less gifted by nature.

It would be difficult to suggest any remedy for these two causes of deterioration; and all the more difficult, because that the motives from which they originate are in themselves laudable ones. It is laudable, no doubt, in a young woman to seek to raise herself from the low and too often immoral condition of an agricultural labourer's daughter to the comparatively respectable condition of a domestic servant, or the still higher status of a schoolmistress. But it is this very rise which prevents her marrying. Regret the fact as one may—and sorry as one is to announce it—yet it is a fact, and whatever raises young women in respectability renders them more unlikely to marry and have children.

III. The next observation I shall make applies to *standing armies and navies.*

As domestic service debars eligible women from marriage, so does military service debar eligible men.

In old times soldiers were called out for a single campaign. And, if they survived it, they returned to their homes and became domestic men, and fathers of families. Now, they are sent to distant lands and unhealthy climates, or are immured in barracks wherein celibacy is almost a condition of their service. In either case they are thus well nigh withdrawn from the matrimonial market. And this enforced celibacy robs the nation of its finest men—those who should have been most encouraged to marry and become fathers of families.

Nor is it only in respect of those who are taken away that military service is prejudicial. It acts also prejudicially in another way, at least in the case of the higher and middle classes. For the elimination of the more attractive men gives to the weak and feeble who remain at home a better facility for marrying; which, if they used by choosing for themselves the most gifted women, would so far neutralize the evil. But that is what they do not do. Such men are shy and afraid of being refused, and, therefore, they take a passive rather than an active part. Instead of seeking out the women whom they prefer, they accept the women who seek them out. They also shrink from the idea of marrying wives whose attractions may hereafter give them cause for jealousy, and they prefer the advantages of fortune and rank which are not accompanied with the same drawback. Besides which, they live much at home under the influence of their mothers and sisters, who naturally wish them to make good positions in life rather than seek wives who have personal attractions only.

IV. The next circumstance I will mention is *the immunity to marry which is afforded to idiots and imbeciles.*

In our Government asylums and many of our union houses idiots are taught trades. And, much to the credit of the teachers who are employed in this seemingly hopeless task, some of them acquire considerable skill in their respective occupations. And so far, is good. But what follows as the consequence of this? Idiots, after being enabled to maintain themselves, are considered no longer objects of charity, and are sent back from the asylums to their homes. The lad who has been taught carpentry returns to his village, and there he marries, and may have a large family. The sempstress also is sent back, to provide for herself by needle-work; and she *does* provide for herself, but in a different way from that which was intended. And thus idiots are produced generation after generation.

I hear some one say, "What! would you be unkind to these poor beings?" I answer, "No! but I would not let them produce other poor beings to the detriment of our race."

If the Government takes in hand a helpless child, whom its parents cannot maintain, and provides it with sustenance and comforts, that Government has surely a right to a control in its subsequent actions. And, I think, it is not too much to ask that the Government should thus continue a control over the persons

whom it has maintained, until they have passed the marriageable age. A stipulation might be made with the parents to that effect. Nor can it be said that such a proceeding would be out of character with the usual course of our legislation. We live under a paternal government, which, free and liberal as it is, never hesitates to exercise its power when the true interests of its children are concerned. The Parliament which passed the Contagious Diseases Acts might certainly find a way to prevent idiots from marrying and having children.

Thus I have mentioned some circumstances connected with our social organization which I think likely to affect the well-being of our race. Many others will, no doubt, occur to your minds, though they have hitherto attracted only occasional notice, and have not been followed out by any systematic inquiries. Such, for instance, as consanguineous marriages, mental impressions, and human hybridity. But I have need only to refer to them to show that they are not of a nature to be dwelt upon here, and I shall therefore conclude with one practical remark.

Seeing that our minds and bodies and dispositions are derived from our ancestors, it is, I contend, a duty incumbent on every human being to select for his or her partner one whose ancestors have been free from bodily and mental defects, at least as far as these can be ascertained. And, therefore, it is the duty of the State to make accessible all possible means of information which can assist them in their researches, so far as is consistent with individual liberty. The registers, for instance, might present many more facts than they do at present.

The birth register might contain not only the name and surname of the child's parents, with their rank or profession, but also the maiden name of the mother, her age, and the number of children she has previously borne. The death register likewise would be far more useful if it gave the maiden names of deceased women as a help in tracing their pedigrees; and there might be a general register of diseases, in addition to those which name causes of death. This latter plan has been found highly valuable in the conduct of life assurances, and there can be no valid reason why the world at large should not have access to similar records. So much, in truth, has the plan met with the approval of medical men that it has already formed the subject of a petition; and, notwithstanding the difficulties which are in the way of carrying it out, it will most likely be adopted before many years are passed.

Further with regard to the census, the paragraph in the householder's schedule in which Government promises to observe secrecy might be omitted. The promise was needful when the census was a new institution, because it was thought that people would be reluctant to give answers unless some such precaution were taken. But now that it has become a recognized institution, and people know by experience that no harm will ensue from answering inquiries and that refusal means penalty, they give information readily.

Supposing then this promise of secrecy be omitted, and the

census be opened to public inspection and be made quinquennial instead of decennial as now, and a system of photography be connected with it—a plan which is not impossible, looking to the extraordinary progress which photography has made as well in cheapness as in excellence—the tables in connection with the registers will offer a vast boon to the public. For every man purposing to unite himself with a family would, by aid of these documents, pictorial or otherwise, be enabled to discover the antecedents of that family; and a father whose daughter's hand was asked in marriage might save his posterity a world of suffering by some fact he happened to ascertain through the same means.

I am well aware that if all these improvements were carried out a very small number of persons would yet avail themselves of their benefit—as indeed it is only a very small number who turn to any public boon which does not coincide with the fashion of the times. But a day may come when hereditary influence will be as much considered in relation to human beings as it now is in reference to sheep and oxen, and when what I have named may be the means of saving posterity, as far as its material existence is concerned, a world of suffering both mental and bodily.

E. WYATT-EDGELL.

The following papers were also read in this Section:—

"On Simplicity, Common Sense, and Intelligent Supervision in Sanitary Appliances," by Mr. PETER HINCKES BIRD, F.R.C.S. (C.S.S., Cantab.).

"On Nature's Hygiene," by Mr. F. C. KINGSETTE, F.C.S.

SECTION II.

ENGINEERING AND SANITARY CONSTRUCTION.

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The President of the Section, Captain Douglas Galton, C.B., delivered the following Address :—

The President of the Congress, Dr. Richardson, has explained to you in his lucid address that the life of man on this globe might reasonably be expected to extend far beyond that to which he now ordinarily attains, provided he were removed from all the conditions unfavourable to long life which encompass him. Of these conditions some are hereditary, some arise from habits and are personal to the individual.

But there is another large class of conditions which are the direct result of the circumstances to which man is exposed in consequence of living in communities.

All living beings are in a continual condition of change, which results in their throwing off from the body matters which poison earth, air and water, unless space, time and opportunity are afforded for the counteraction of these deleterious effects.

Epidemic diseases are observed to occur in very different degrees of intensity at different periods, amongst groups of population exposed to certain unhealthy conditions. Sometimes they take the form of pestilences, and immediately afterwards, the conditions remaining the same, they subside and all but disappear, again to renew their ravages at some future period.

A careful examination of their phenomena has led to the discovery that whilst we have no knowledge of the causes which made these epidemics break out at one time and not at another, there are certain well-defined conditions which influence most materially not only their actual intensity, but also their frequency.

Thus, intermittent fever was observed to disappear from places which it formerly ravaged, after drainage of the soil and improved cultivation.

It was next discovered that by cleanliness, fresh air, and

diminished crowding the worst forms of pestilential fever, which used to commit ravages similar to those of the plague, disappeared entirely from English gaols.

The breathing of foul air contaminated by the breath of other persons appears to be the special agent which predisposes people to consumption and diseases of that class.

Zymotic diseases, namely, fevers, diarrhœa, cholera, dysentery, &c. are most intensely active where there is overcrowding, and the repeated breathing of air already breathed, such air being further contaminated by moisture and exhalations from the skin; and where there are emanations proceeding from animal excretions, or from decaying vegetable matter, together with moisture, from the want of drainage from urinals, cesspits, and manure heaps. Moreover, cholera and dysentery are intimately connected with the condition of the water supply; while an epidemic prevails, the question whether a given population shall suffer or escape may almost be predicted from a chemical analysis of the drinking water.

It is to the physiologist and the chemist that we must look for the causes from which these baneful effects arise, and what are the conditions which should be altered to prevent or remove them.

The engineer steps in after these causes have been pointed out, and it is for him to design the methods of prevention or removal.

Five hundred years ago the population of the whole kingdom was only equal to the present population of the metropolis. When the first recorded census was taken in 1801, the population of England and Wales was less than 9,000,000; it has now reached nearly 25,000,000. We are crowded together as we never were crowded before; our pursuits are more sedentary, our habits more luxurious; houses increase in number, land is more valuable, the green fields more remote; our children are reared among bricks and paving-stones. It is daily becoming more and more impossible in the question of health for any one member of a community to separate his interest from that of his neighbours. If he places his house away from others the air which he breathes may receive contamination from the neighbouring district; the dirty water which he throws away may pollute the stream from which his neighbours draw their supply; and when a population congregates into towns the influence of the proceedings of each individual on his neighbour becomes strongly apparent.

In places where many dwellings are congregated together, the requirements for health may be classed as—first, those that are

common to the community, such as the supply of good water, the removal of foul water, and the removal of refuse matter; and secondly, those which immediately concern the individual householder, such as the condition of his house and the circumstances of its occupation.

But the existence of some danger to health in horses in towns or villages may be a source of danger to the houses around. In my own case, illness was caused by my next-door neighbour having a defective soil-pipe, the sewer-gas from which passed through the wall. This was a danger from which perfect drainage in my house afforded no protection.

On these and similar grounds, it is the interest of every person in a community that every other member of the community should live under conditions favourable to health.

Each year as the population increases and as dwellings multiply, so does the importance of promoting these conditions increase; and so long as preventable diseases exist throughout the country, we must not delude ourselves with the idea that we have done more than touch the borders of Sanitary improvement.

There are few subjects in which so many professions of progress have been made in the last few years as in the theoretical knowledge of how to provide a healthy dwelling and a healthy town.

Books innumerable have been written upon the question. Physiologists have invented every conceivable theory; patentees have invented every conceivable description of apparatus; engineers, architects, and builders overwhelm you with professions of their knowledge of Sanitary principles, and millions of money have been spent in furthering the schemes they have devised; and yet, in spite of all these efforts, there are very few houses and very few towns where you would not easily detect some grievous Sanitary blunders.

I believe this to be due, in the first place, to the fact that the majority of men prefer anything to thinking for themselves. They like to obtain their knowledge as they do their hats—from a shop, ready-made. They will accept theories laid down by some one else rather than laboriously collect the facts and reason carefully upon them. The result has been that money has sometimes been expended upon theoretical suggestions which have later proved to be fallacies; the money has been wasted, and then discouragement has followed. There is perhaps no branch of public work in which onesidedness has done more mischief than in measures for so-called

improvement of public health. If expenditure had only taken place on observed facts and experience, we should be now standing in a more advanced position than we at present occupy.

In the second place, the Sanitary education of the country has not been brought into a system. People seem to have thought that Sanitary knowledge could be picked up anyhow. Important questions of drainage, of water supply, of ventilation, have in many instances been committed to persons who had a good education in general architectural or engineering knowledge, in the nature and use of materials, and other such matters, but who had never received any special training in the Sanitary side of engineering. Yet the problems which the Sanitary engineer and architect are called on to solve require for their solution a knowledge of the higher branches of physics, chemistry, geology, meteorology, and kindred sciences, and entail as close habits of observation as any other branch of the engineering profession.

In the third place, it has always seemed to me that the system under which the Government advances money for Sanitary works, whilst of great *primâ facie* advantage in one point of view, yet has its disadvantageous aspect.

The facility with which Corporations and Local Boards have been enabled to borrow money at a low rate of interest has no doubt had the effect of inducing a more immediate expenditure for Sanitary works than would have taken place without this aid.

But the expenditure has not, in all cases, been so carefully considered beforehand as would probably have been the case if the towns had been left to raise the money without Government aid.

The result has been that much money has sometimes been spent where it has been subsequently seen that less money, carefully and judiciously applied, would have sufficed.

There has also been in the system of loans to towns a tutelage by the Government, which diminishes responsibility.

Where a loan is applied for, the plan upon which the money is to be spent is submitted for Government approval. The Government only lends the money after the approval of the proposed scheme of expenditure by one of their inspectors.

The Local Authorities of the towns to be drained cannot therefore be responsible for the plan selected; for the Local Authorities must alter their plans to suit the views of the inspector. The responsibility of the engineer is diminished, because he may be compelled to modify his plan in a manner of which he may not

thoroughly approve; and the inspector has no responsibility in the matter, because, after having approved of the general scheme, he has no control over the details or the execution of the work, nor can he be in any way held responsible if the result were a failure.

Indeed, after the money has been once borrowed, there is no certainty that it need be spent in accordance with the plans. I have heard a rumour that, in one instance at least, a scheme has been approved, the money has been borrowed, and never spent at all on the work on account of which it was borrowed.

Nor is there any apparent reason why the Government should have come forward to press money upon the Corporations.

The plan adopted by the Government in former times for promoting land drainage would have answered equally well in the case of sewerage works.

The Government commenced by assisting landowners, with loans granted on the security of their estates, the money being expended on a system of drainage approved by the Government inspector. But when the system had been initiated, private enterprise was allowed to take its place, and companies were formed who advanced the money and employed leading engineers to advise upon its expenditure; and the intervention of the Government was no longer necessary.

A similiar course of proceeding would have been applicable in the case of town drainage. If the Government, instead of becoming themselves money-lenders on so large a scale, and thus constituting their inspectors the sole advisers on matters of drainage, had passed an Act of Parliament enabling any town to borrow an amount of money, bearing a due proportion to the rateable value of the town, a sound security would have been created; and if large companies had taken upon themselves the function of lending to towns under a system similar to that in force for land drainage, viz., of satisfying themselves, through the advice of a leading engineer, of the probable efficiency of the plans for which money was advanced, a greater scope would have been afforded for progress in Sanitary Science. Indeed, I cannot but think that we should have reached a higher level of Sanitary improvement in this country than now prevails, if the Government had limited itself to its more legitimate functions, viz., first, the enactment of laws requiring Sanitary defects to be removed; and second, the promotion of measures for diffusing a sound education in Sanitary knowledge; instead of pursuing the course of endeavouring to dictate the exact measures to be followed in each case.

But it may be asked, What is Sanitary knowledge? It is frequently assumed that drainage and water-supply are the principal subjects which are embraced in the term; but these only make up a small part of the subject.

At the present time there does not exist any treatise which brings to a focus the various problems of mechanical and physical science, upon which Sanitary knowledge is based. The variety of these problems will be best illustrated by a few instances.

A sanitarian tells us that health depends on pure air and pure water. If a site is to be selected, it requires a consideration of its position with respect to its surroundings. It requires a knowledge of the temperature of the air and of the soil; what are the prevailing winds; what is the amount and incidence of the rainfall; and what is the percolative capacity of the soil.

The engineer cannot interfere with the general conditions of a climate, but he may produce important changes in the immediate surroundings of a locality; he may modify the condition and temperature of the soil; he may control atmospheric damp; he may arrange for the rapid removal of rainfall, or he may cause the rainfall to be retained in the soil, to be given out gradually in springs, instead of passing away in torrents to flood the neighbouring districts.

In the Island of Ascension, the power of retention of water in the soil exercised by the planting of trees was exemplified. That island formed a convenient point for ships to call at for obtaining water on their way home from the East Indies. It was a barren rock, to which formerly the water had to be conveyed in ships. About fifty years ago trees were planted on the island. These have thriven, and now the rain which falls, instead of passing away at once into the atmosphere by evaporation, is retained in a sufficient quantity to enable the water to be collected for the supply of the ships which call at the island.

The engineer may modify the incidence of disease. Algeria, perhaps, offers some of the best illustrations of the manner in which engineering operations have remedied the evils of the proximity of marshes. Bona stands on a hill overlooking the sea; a plain of a deep rich vegetable soil extends southwards from it, but little raised above the sea level. The plain receives not only the rainfall which falls on its surface, but the water from adjacent mountains, and is consequently saturated with wet. The population living on and near this plain suffered intensely from fever: entire regiments were destroyed by death and disease. It was at last determined to drain

the plain. The result of this work was an immediate reduction of the sick and death-rate.

Fondouc, in Algeria, is situated on sloping ground, immediately above the marshy plain of the Mitidja; mountain ranges rise immediately behind it. It was first occupied in 1844, and in the succeeding year half the population was swept away by fevers and dysentery. During the first twenty years the mortality was 10 per cent. The surrounding marsh has since been drained and cultivated, and the mortality now is 20 per 1000.

Similar instances may be quoted from our own possessions in India.

In the northern Doab districts in the north-west provinces of India the excessive fever mortality for which these districts were noted has been mitigated by extensive drainage works, by means of which the water which formerly stagnated in the land is now led away by continuously flowing streams.

When a site has been selected, it is necessary to consider the question of the subsoil.

The air does not cease where the ground begins, but air permeates the ground and occupies every space not filled by solid matter or by water. Thus, it is the same thing to build on a dry gravelly soil, where the interstices between the stones are naturally somewhat large, as to build over a stratum of air. The air moves in and out of the soil in proportion to barometric pressure, and with reference to the wind. If there is much water in the soil, the air carries with it watery vapours, and is cold, and such a site is called damp.

A site with a high water level is, as a rule, more unhealthy than a site with a low water level; but a site with a fluctuating water level is most unhealthy. The Sanitary engineer can control the water level in the soil, or construct works to remedy the evils of a wet site.

There is also a considerable quantity of carbonic acid in the soil. It varies at different depths; it has been found to vary greatly even in localities in close proximity. The processes going on in the soil in these several places are therefore probably very different. Each will have its influence on the ground air. One evil arising from a foul subsoil is very apparent. In cold weather the temperature of a house is warmer than that of the outer air. If a house is built on soil containing deleterious matters, the impure air will be drawn into the house by the action of the warm air of the house. The Sanitary constructor takes measures to check the passage of air between the house and the ground under and around it. The fact

of this continual free passage of air in and out of the ground makes it important that not only should the ground lived on be free from water, but that it should also be free from impurities. It would be just as healthy (indeed, probably far healthier) to live over a pigsty than over a site in which refuse has been buried, or in which sewer water has penetrated, or over a soil filled with decaying organic matter; thus, before building on any ground, its nature should be carefully examined.

What then can be more dangerous, what more wicked, than the everyday proceedings, in the metropolis and elsewhere, of those persons who purchase a building site, who extract from it the healthy clean gravel and sand which it contains, allow the hole to be filled up with rubbish, and then proceed to build upon it?

When the site has been selected, the Sanitary architect has to consider how he will distribute buildings over it. The deteriorating effect of residence in towns has been frequently noticed.

The Registrar-General has shown that a population of 12,892,982 persons living on 3,183,965 acres in the districts comprising the chief towns of England, showed an average death-rate for ten years of 24·4 per 1000; whilst a population of 9,819,284 living on 34,135,256 acres in districts comprising small towns and country parishes showed an average death-rate for a similar period of 19·4 per 1000.

It has been calculated that of the adult population of London 53 per cent., of that of Birmingham 49 per cent., of that of Manchester 50 per cent., and of Liverpool 62 per cent., were immigrants from the country settled in the town, and that the majority of the incomers were men and women in the prime of life.

The mortality in these four towns averaged 26 per 1000 against 19 per 1000 in the adjacent country districts; the mortality of persons under the age of 15 being 40·7 per 1000 in these towns against 22 per 1000 in the country districts.

The marriages in the city population were four times as numerous as in the agricultural counties, but the births in the town population only exceeded those in the agricultural population by one-sixth.

When we consider the causes of low health in towns, it becomes apparent that the extraordinary degree of unhealthiness is unnecessary.

It will be found to result from absence of circulation of air through and between buildings, and from the retention near or in

houses, and in streets, of much polluting matter. The following figures illustrate this :—

St. Anne's, Soho, with	331 inhabitants per acre,	shows a	death-rate of		24·16 per 1000.	
Eltham,	„ 1·04	do.	do.	do.	18·8	do.
The Model Lodging-Houses, with .	860	do.	do.	do.	16·	do.
Do. do.	1140	do.	do.	do.	18·	do.

Thus some of the model lodging-houses are as healthy as a country district.

The superior healthiness of the model lodging-houses is due in a measure to the careful provision of Sanitary arrangements, but principally to the fact that the numerous stories in these buildings, whilst affording accommodation for a dense population on a limited area, are provided with free through ventilation, and allow of ample space all around for the circulation of air, as well as to the fact that impurities are not allowed to be retained on the open area around them.

The health of any building is dependent upon free and moving pure air, outside and inside its walls; anything which interferes with this first condition of health is injurious. And it follows that in towns, where land is dear and a large number of persons are crowded on a given area, better ventilation and circulation of air may be obtained by placing dwellings in stories one above the other, and leaving spaces between the buildings, than by placing them in one-storied buildings which would be too close together to allow of circulation of air round the building.

The next step in knowledge of Sanitary construction is to learn how to obtain pure air in a building. What is pure air? Where are the impurities which make the air of a town so different from the fresh air of the country? The volume of sulphuric acid from coal thrown up by our fires into London air is enormous. A cubic yard of London air has been found to contain 19 grains of sulphurous acid. The street dust and mud is full of ammonia from horse-dung. The gases from the sewers pour into the town air.

Our civilization compels us to live in houses, and to maintain a temperature different from that out of doors. What are the conditions as to change under which we exist out of doors?

The movement of the air is stated in the Registrar-General's reports to be about 12 miles an hour on an average or rather more than 17 feet per second. It will rarely be much below 6 feet per second.

Imagine a frame about the height and width of a human body, measuring about 6 feet by $1\frac{1}{2}$, or 9 square feet: multiplying this by

the velocity of movement of the air at 6 feet a second, it will appear that in one second 54 cubic feet, in one minute 3240 cubic feet, in one hour 196,400 cubic feet of air would flow over one person in the open.

In a room the conditions are very different. In barracks, in a temperate climate, 600 cubic feet is the space allotted by regulation to each soldier; and when in hospital from 1000 to 2500 cubic feet to each patient.

If it were desired to supply in a room a volume of fresh air comparable with that supplied out of doors, it would be necessary to change the air of the room from once to five times in every minute, but this would be a practical impossibility; and, even if it were possible, would entail conditions very disagreeable to the occupants.

Hence, to maintain the comfort and temperature we desire indoors, we sacrifice purity of air. Therefore, however impure the outer air is, that of our houses is less pure; and it may be accepted as an axiom that by the best ventilating arrangements we can only get air of a certain standard of impurity, and that any ventilating arrangements are only makeshifts to assist in remedying the evils to which we are exposed from the necessity of obtaining an atmosphere in our houses different in temperature from that of the outer air.

On the other hand, why should we not do our best to obtain as pure air as we can? It has been recently shown that the soot and many deleterious matters from smoke may be easily removed by passing the smoke through spray on its way to the chimney. This would remove much impurity from town air; but until such a system of purifying town air is adopted, we can improve the air in our houses by removing the suspended matter from the inflowing air by filtration. Moreover, these suspended matters exist in much smaller quantities at an altitude; at 100 feet they are greatly diminished, at 300 feet the air is comparatively pure. In Paris the air for the Legislative Assembly is drawn down from a height of 180 feet, so as to be taken from a point above many of the impurities of the town atmosphere. That is a reasonable and sensible arrangement, and might be usefully adopted in public buildings in towns. In the Houses of Parliament, the so-called fresh air is taken from courtyards on the street level, from which horse traffic is not excluded.

The maintenance of the standard of purity, or rather impurity, in a building, depends on ventilating arrangements. Ventilation

chiefly depends on the laws which govern the movement of air, its dilatation by heat or contraction by cold; or, if ventilation is effected by pumps and fans, then upon the laws of the motion of air in channels, the friction they entail, and similar questions; therefore all these are matters for careful study.

But when we apply the study to practice, other considerations occur. We are told by theory that a room containing an air space of 1000 cubic feet, occupied by one individual, would require to be supplied with 3000 cubic feet per hour, in order to maintain it in a proper condition of purity and humidity. But in our temperate climate, a careful practical examination of the condition of barrack-rooms and hospitals, judged of by the test of smell, showed that arrangements which appear to provide for a volume of air much less in amount than that obtained by calculation will keep the room in a fair condition.

These results have pointed to about 1200 cubic feet of air admitted per man per hour in barrack-rooms occupied by persons in health.

This need not be set down to errors in calculation or in theory.

There are many data which cannot be brought into the theoretical calculation. For instance, the carbonic acid disappears in a newly plastered or lime-washed room, and could be recovered from the lime, therefore a newly cleaned, lime-whited room will present different conditions from a long-occupied, dirty room. Washing with quicklime destroys fungi in dirty walls; the same effect is produced by sulphurous acid fumigation. Air has the same property, especially dry air; and hence, opening windows, turning down beds, and all such measures, act directly on the subsequent state of the air. Therefore an enormous effect is produced on all the elements of the above calculation if the windows of a room are kept open for several hours a day, instead of being closed.

Besides this, the conditions under which the air flows in and out of a room are so varied. The walls and ceiling themselves allow of a considerable passage of air.

The ceiling affords a ready instance of porosity. An old ceiling, it will be observed, is blackened where the plaster has nothing over it to check the passage of air, whilst under the joists, where the air has not passed so freely, it is less black. On breaking the plaster, it will be found that its blackness has arisen from its having acted like a filter, and retained the smoky particles, while the air passed through.

Ill-fitting doors and windows allow of the passage of a considerable quantity of air.

In a temperate climate, where the changes of temperature of the outer air are rapid and considerable, these means of producing the outflow from and the inflow of air into a confined space are in constant operation. A sleeping-room is very warm when occupied at night, a rapid fall of temperature outside occurs, and at once a considerable movement of air takes place.

It may be summed up that, whatever the cubic space, the air in a confined space occupied by living beings may be assumed to attain a permanent degree of purity, or rather impurity, theoretically dependent upon the rate at which emanations are given out by the breathing and other exhalations of the occupants, and upon the rate at which fresh air is admitted, and that, therefore, the same supply of air will equally well ventilate any space, but the larger the cubic space the longer it will be before the air in it attains its permanent condition of impurity. Moreover, the larger the cubic space, the more easily will the supply of fresh air be brought in without altering the temperature, and without causing injurious draughts. One of the chief difficulties of ventilation arises from the draughts occasioned thereby. Everyone approves of ventilation in theory, but practically no one likes to perceive any movement of air.

These conditions point to the care which should be exercised in the form of rooms, the position of windows, doors, fireplaces, and other matters. We should study how the currents of air move in a room: what is the effect of the form of room on the circulation of these currents of air; for instance, a lofty room with the tops of windows some distance below the ceiling, and without outlets for air at the ceiling level, becomes dangerous, unless a constant circulation of air goes on, because the heated air, loaded with impurities, ascends, stagnates in the space near the ceiling, cools, and falls down, and re-mixes with the air in the lower part of the room, and thus increases in impurity.

These effects are modified by anything which causes circulation of the air. The open fireplace creates circulation of air in a room, with closed doors and windows. The air is drawn along the floor towards the grate; it is then warmed by the heat which pervades all objects near the fire, and part is carried up the chimney with the smoke, whilst the remainder, partly in consequence of the warmth it has acquired from the fire, and partly owing to the

impetus created in its movement towards the fire, flows upwards towards the ceiling near the chimney breast. It passes along the ceiling, and, as it cools in its progress towards the opposite wall, descends to the floor, to be again drawn towards the fireplace.

Thus the open fire, whilst continually removing a certain quantity of air from the room, which must be replaced by fresh air, causes an efficient circulation of the air remaining in the room.

Moreover, a room warmed by an open fire is pleasanter than a room warmed by hot-water pipes.

A warm body radiates heat to a colder body near to it. The heat rays from a flame or from incandescent matter pass through the air without heating it; they warm the solid bodies upon which they impinge, and these warm the air.

Where the source of heat in a room consists of hot-water pipes, or low-pressure steam pipes, the air is first warmed, and imparts its heat to the walls. The air is thus warmer than the walls. When a room is warmed by an open fire, on the other hand, the warming is effected by the radiant heat from the fire, which passes through the air without sensibly warming it; the radiant heat warms the walls and furniture, and these impart their heat to the air. Therefore the walls in this case are warmer than the air. Consequently, in two rooms, one warmed by an open fire, and the other by hot-water pipes, and with air at the same temperature in both rooms, the walls in the room heated by hot-water pipes would be some degrees colder than the air in the room, and therefore colder than the walls of a room heated by an open fire; and these colder walls would therefore abstract heat from the occupants by radiation more rapidly than would be the case in the room heated by an open fire. And to bring the walls in the room heated with hot-water pipes to the same temperature as the walls in the rooms heated by the open fire would require the air of the room to be heated to an amount beyond that necessary for comfort, and therefore to a greater amount than is desirable. Moreover, warmed air contains less oxygen than cooler air, and as sick persons are more sensitive to such influences than persons in health, these may be the reasons why, in hospital wards, the warming by means of an open fire has been always preferred to warming by hot air or hot-water pipes.

With complicated buildings, such as theatres, legislative assemblies, prisons, &c., the problems of ventilation are more difficult and intricate, but all are based on the same principles of the movement of air.

Another group of questions relating to Sanitary construction are: What are the best materials for the house, and the best distribution of those materials? How can the less pure air from the ground be prevented from entering the house through the basement? What is the effect of the porosity of materials on the health of the inmates of a house? What is the law which regulates the loss of heat through walls and windows, skylights and roofs? For instance, if we assume that the loss of heat through a wall nine inches—*i.e.* one brick—thick, with a temperature inside the room two degrees above that outside, would be one unit for a given area of surface of wall, the loss of heat through a wall built of two half bricks—*i.e.* four-and-a-half inches—on each side of a central air space, would be two-thirds of the loss of the solid wall. Similarly the loss of heat through a double window would be about three-fifths of that through a single window. The laws which govern these questions are as complicated as those which govern the strength of materials, or the flow of water, and they form the alphabet of Sanitary building.

Whilst, however, I have limited myself to speaking of a theoretical knowledge, it is of essential importance that the Sanitary architect, builder, or engineer should have also practical technical knowledge of the subject. He should know what constitutes a good material and good workmanship.

One instance of the Sanitary importance of the quality of materials will suffice here. Dust and impurities adhere less to glass of a good quality than to glass of a bad quality, because the surface of the latter becomes rough much more rapidly than the surface of glass of good quality.

But there is one branch of work connected with water supply and drainage in which practical knowledge is especially necessary, and which has not been so prominently considered as it should be. I mean the details of the plumber's work, and the work connected with house drains. However well you may design your house drains, the whole of your design may be rendered nugatory by apparently trifling mistakes or carelessness in the details. Your trap may be excellent, but the junction with the pipe may be faulty. It is easy to conceal a bad joint; it is long before the defects in a badly-laid drain will become apparent if the drain is buried underground. Therefore, it is not only the officers of the army of Sanitary constructors who require knowledge and education, but the foremen and the labourers, each in his own degree.

I have thus specially called attention to these points of Sanitary construction, because they are not in general sufficiently dwelt upon; and the popular idea seems often to be that Sanitary engineering means drainage and water supply alone. I would not derogate from the enormous importance of these matters; but public attention has been so largely directed to water supply and drainage—especially here at Croydon, where your eminent townsman, Mr. Baldwin Latham, has done so much, and there are such eminent Sanitarians as vice-presidents of this section, Mr. Grantham, Mr. Bailey Denton, Mr. Rogers Field, and others—that I should only repeat what has been said, much better than I could say it, by many before, if I continued my *résumé* of what makes up Sanitary knowledge by saying much upon those branches of the subject.

I cannot refrain, however, from offering a few remaks upon these subjects, which at the present time necessarily fill the public mind.

We derive our whole water supply from the rainfall. If it falls on an impervious surface, it runs off in rivers above ground; if it falls on a pervious surface, it runs off underground in rivers whose direction of flow will depend on the geological formation. However much our population may grow, we cannot therefore increase our supply; but we may store it and utilize it if we obtain a knowledge of where it falls and where it flows to. It is thus the function of the Sanitary engineer to trace the course of these water supplies. But rain does not fall equally over the whole country. On the contrary, as has been so well shown by Mr. Symons, there is in some localities in England an enormous surplus, and in other localities a bare supply, and the incidence of these supplies has no reference to the spread of population over the country; thus it requires something beyond local organization to arrange for a distribution of the supply in accordance with the relative wants of the country. It is on these grounds essentially the duty of the Government to take up this question.

The Government have taken into their hands the more theoretical question as to when storms may be expected; but they have not taken in hand the question which has an enormously greater practical importance, viz., that of watching over our water supplies, although it is on the careful use of these that the health of the whole country depends. The first step towards obtaining a clear understanding of the question is to bring all the information on

this subject to a focus. At the present time there are certain important public departments, the information collected by which bears materially on the Sanitary condition of the country; and yet these departments are scattered about indiscriminately, as if with the intention of preventing the information they already possess, and could so easily add to, from being brought to any useful focus.

The departments to which I allude are—

1st. The Ordnance Survey, which is under the First Commissioner of Works, probably of all departments of the Government the one least qualified to administer it usefully. The Ordnance Survey was originally undertaken on the one-inch scale for military purposes. The military map has long been complete. A survey was, however, commenced on an enlarged scale many years ago, which affords an admirable map for Sanitary purposes. But the progress is so slow, that a large portion of England remains unmapped, except on the old one-inch scale.

2nd. The Geological Survey, which is under the Privy Council, and whose progress also is very slow.

3rd. The Registrar-General's Department, which is attached to the Local Government Board.

4th. The Meteorological Office, which is under the Board of Trade.

The first step is to bring these departments under one general head, so that the information they can severally afford may be properly correlated. The Local Government Board would seem to be the department under which they would most naturally fall; and a department should be added for registering the distribution of rainfall over the British Isles on the plan initiated by the enterprize of Mr. Symons.

By means of this machinery the information bearing on the water supplies of the country, which is in existence, could be easily collected and made available, and the Government and Parliament would then be in a more favourable position for considering the necessity and, if such necessity exists, the means, of enabling the districts furnished with a copious water supply to assist the less favoured districts.

On the question of sewage, time would not allow me to enter; it is sufficient to say that this must remain always a problem for the Sanitary engineer, because no one system of sewage could be adopted universally; the peculiarities of different localities require different methods of treatment.

Where land at a reasonable price can be procured, with favourable natural gradients, with soil of a suitable quality and in a sufficient quantity, a sewage farm, if properly conducted, is apparently the best method of disposing of water-carried sewage.

In the case of towns, where land is not readily obtained at a moderate price, some of the processes, based upon subsidence, precipitation, or filtration, produce a sufficiently purified effluent for discharge, without injurious result, into watercourses and rivers, provided the volume of water into which it is discharged is of sufficient magnitude to effect a considerable dilution. But, as a rule, no profit can be derived at present from sewerage utilization.

With dry systems, where collection at short intervals is properly carried out, the result, as regards health, appears to be satisfactory.

For health's sake, without consideration of commercial profit, sewage and excreta must be got rid of at any cost.

My object in this *résumé* has been to endeavour to show how extensive is the field of knowledge which has to be traversed by those who undertake the duty of building healthy houses, and of watching over the arrangements for securing the health of towns.

The researches of the physiologist and the medical man into the laws which govern the prevalence of diseases have enabled them by the accumulation of information to lay down the principles upon which healthy construction should rest; it is the duty of the architect, the builder, the engineer, and the surveyor to apply these principles; and their correct application is as essential to the efficient construction of a dwelling as is the quality or strength of materials which are used.

The acquisition of Sanitary knowledge covers a vast area of ground, and requires special study.

The universities of Oxford, Cambridge, and London, instituted examinations in public health, but with little success; few candidates came forward, and indeed no candidates offered themselves for Oxford and London at the last examination. The reason is obvious. It is, in the first place, not sufficiently understood by the community that the Sanitary architect, builder, or engineer requires special knowledge. But if it were understood, there is, at the present time, no place or institution where this knowledge can be acquired.

The universities have instituted no chairs of Sanitary instruction. It is not taught in schools. But until some means of

obtaining the education can be afforded, it is of little avail to establish examinations, or offer to give degrees.

The Sanitary Institute, whose *raison d'être* is to promote Sanitary progress, has from the first recognized the importance of developing Sanitary education, and has now decided to come forward as its champion. With this object the Sanitary Institute proposes to organize a course of lectures to be delivered, in the practical branches of this question, during the coming winter, and in this effort they are about to make for the public good the Council trust that they will receive the support of all those interested in Sanitary progress.

There is, however, a further step required in order to produce throughout the country a due recognition of the importance of Sanitary knowledge, and this step should be at once taken. The Medical Officers of Health, who are the advisers of the local authorities on questions connected with public health, have obtained a title to their position in the medical profession by virtue of certificates from qualified Boards of Examiners. But local surveyors, whose duty it is to advise local authorities on matters of Sanitary construction, are not required to produce any such certificate of qualification. In many instances, local surveyors, who should be the guides of the people in Sanitary matters, do not sufficiently appreciate the subject on which they should advise. If steady and continuous progress is to be made in Sanitary construction throughout the country, it is essential that the surveyors should receive a sound education on this special part of their profession.

The summary of the conclusions to which I would lead you in this address are, therefore—

1. That endeavours should be made to cause the adoption in educational establishments of courses of systematic education in Sanitary Science for those who undertake the business of Sanitary construction.

2. That no person should be appointed to the office of surveyor of a Local Board or Corporation without a certificate, from some duly qualified educational institution, of proficiency in practical Sanitary Science.

Douglas Galton, hon. d.c.l., f.r.s.,
President of Section.

Remarks on Certain Points in the Work of the Engineer which have a Direct Bearing on Public Health.

For some time past, I have been strongly impressed with the advantage to be gained from authoritative determination of certain points in Sanitary engineering, which would be accepted as conclusive by the country at large. I have been brought to this conclusion from finding that there still prevails a hesitation to adopt what the majority of experienced Sanitary engineers and medical authorities consider settled, and that this hesitation is not confined to local boards and local surveyors, but extends to influential persons whose opinions greatly prejudice the permanent character of works.

It can be well understood why the present Local Government Board, as the central authority, should refrain from imposing positive rules to override the judgments of independent engineers and local surveyors, for the experience gained since the Public Health Act of 1848 has brought home to all engineers alike the fact that the dicta then pronounced as fixed have led to conflicting results, and have deterred people from accepting as final certain principles and views which the experience gained since 1848 would long ago have established.

There are many points, indeed, upon which it is most desirable for the nation at large that this hesitation should cease to exist, and I will select a few illustrations—very different but equally important in character—to prove this statement, hoping that a means will be found of establishing some body in the shape of a council or commission, composed of the highest authorities that can be brought together, who shall conclusively decide them. I will place these few illustrations before you in the shape of questions, beginning with one of a fundamental nature, and at the same time state my own views, in the hope of eliciting discussion.

The questions will be as follow :

I. What are the sanitary objects which should be comprised in the duties of a River Conservancy Board ?

II. Should surface-waters be excluded from sewers ?

III. Should the public sewers of urban and rural districts be perfectly ventilated ?

IV. Should all sewers be made water-tight ?

I. The Rivers Conservancy Bill of last session had for its declared object (see sections 9 and 10) the conservancy of rivers and watercourses, and the prevention or mitigation of floods, with powers to enforce the Rivers Pollution Prevention Act, 1876. But although the Conservancy Boards to be created under the Act were to be bound to make periodical surveys of the watercourses within their district (see section 17), the Bill, when it left the House of Lords, contained no provision for securing a supply of water to the inhabitants of the

river basins dealt with by the preservation of these watercourses in a pure condition, or by the storage of unpolluted surface-waters in substitution thereof, or by the raising from the water-bearing strata beneath, an equal quantity of the purest water.

The Bill excluded from its operations the two rivers, Thames and Lee, which are at present controlled by separate Conservancy Boards, and as the proceedings of these somewhat important bodies may guide future boards, I will endeavour to point out how the desiderata of river pollution and water supply are at this time being dealt with by them.

Since the first Act of 1857 constituted the Thames Conservancy Board, the length of river under the jurisdiction of the Board has been extended (by the Act of 1866) from Staines to Cricklade, while the breadth of area which was first confined (by the Act of 1857) to the width of the river itself, has been gradually increased to three miles on each side of the river by the Act of 1867 ; then to five miles by the Act of 1870 ; and, lastly, by that of 1878 to ten miles on each side of the river, making twenty miles by adding the two sides together. Reducing this present breadth of district to superficial area, it will be found that the control of the Board above the intakes of the Water Companies extends to a trifle above three-fourths of the tributary basin, leaving rather less than one-fourth—comprising about half a million acres—over which no conservancy jurisdiction exists, and from which the conservators have to submit to the influx of any polluting matter which may imperceptibly find its way into the river system. I say imperceptibly, because any defilement which was distinctly apparent would probably be met by independent action.

The work of the Thames Conservancy Board has decidedly been very considerable, and great improvement in the condition of the river has resulted from its supervision, but so long as there exists beyond control within the watershed such a wide margin as 800 square miles, you will agree with me that the duty expected of a Conservancy Board cannot be perfectly performed, and that this is the right conclusion is to be inferred from the fact that the Legislature itself, by five different Acts of Parliament, has gradually lengthened and widened the area of control in the manner I have stated.

The river Lee, which supplies two of the largest Water Companies furnishing London with water is not subject to the same restrictions as that which prevails in the Thames basin. By the Lee Conservancy Act, 1868,—which declares the duties of the Board to be the preservation of the purity of the water of the Lee and its tributaries, as well as the improvement of the stream and the maintenance of navigafion works—the tributaries over which jurisdiction is given are particularized without any reference to the minor streams and watercourses which feed those tributaries, and the consequence is that the control of the Board is considerably limited. If this is not the case by the legal interpretation of the Act, it certainly is so in a practical sense.

Upon this point I can speak positively, because I live within the

watershed of the Lee, and the village in which I reside has a population of about 2500 persons, which at this moment is discharging its sewage into a branch of one of the tributaries specified in the Act. This sewage, when it reaches the Lee—as reach it it must—is necessarily mixed with the water consumed by the inhabitants of London.

Other villages of less populations do the like, and the Lee Conservators evidently consider it no part of their duty to prevent such pollution. It will therefore remain until some authority, having jurisdiction over the whole watershed, compels all Sanitary authorities of districts within it to free their liquid refuse of foul and noxious matters.

Although the Local Board (Stevenage) to which I particularly refer was called into existence five years ago, it is the fact that up to this moment it has utterly disregarded the pressure of the Local Government Board, under a belief that, however peremptory the tone of communication may be, nothing will really be done by that Board to enforce compliance. The prospect of a writ of *mandamus* is held in perfect ridicule, and only those inhabitants are elected on the Board who will do nothing of a comprehensive character.

While this pollution of the stream is permitted, its waters still continue to be used for domestic and agricultural purposes by the people who live on its banks below. At the same time, the inhabitants of the village committing the wrong derive their own water-supply from wells of various depths, which are fed by percolation from the surface, although there exists immediately under their feet, at a depth of about 100 ft., the pure and never-failing supply of the great chalk basin. The consequence is, that while the Local Board by inaction is rendering the water of the stream into which the sewage of the district is discharged unfit for use by man and beast, the inhabitants live constantly liable to endemic maladies whenever dry seasons recur.

This homely illustration of the want of some presiding local authority is only one of many that I could quote as existing in the same watershed, but I hope it will suffice to show that any control by Conservancy Boards that does not extend from the main trunk and its tributaries up to the extreme margin of the river basin, and does not turn to use the subterranean sources of supply by the exercise of powers such as were embodied in the 26th section of the Rivers Conservancy Bill of which I have spoken, must fail to secure the sanitary benefit the country should demand. The section I refer to (the 26th) empowers a Conservancy Board to charge upon a part of a watershed—a private improvement rate to discharge any special outlay which may be authorized by the Act, and surely, as their duties extend to the preservation of the purity of water, the provision of water to villages should be one branch of duty. To tax the upland portions of a river basin (as intended by the 5th section of the Bill) towards the cost of improving main outfalls, on the ground that they throw down their surplus waters to flood the valleys—a charge which is perfectly right in itself—must strike everyone as unjust if the provision of pure water to the

taxed population fail to receive from the Controlling Board the consideration due to so vital a question.

The use as well as abuse of waters feeding our rivers are objects so important to the nation that I trust you will be able to answer the question I have put to you, by declaring that the duties of a Conservancy Board should extend beyond the bed and banks of a river, and the maintenance of navigation works, to the protection from pollution, as far as practicable, of every stream and water-course within the watershed area, and to the substitution of either stored or subterranean supplies, where the purity of the running streams cannot be assured.

II. The next two questions have a somewhat intimate bearing upon each other, as one relates to the admission of surface-waters into the sewers, and the other to the ventilation of sewers.

The two objects may be considered to be related to each other; because, although all engineers know that the air existing in sewers is more or less affected by every fluctuation of the flow of liquid within them, we have ample reason for believing that, in many cases where unsatisfactory Sanitary results have followed the adoption of systematic sewerage, they have been due to the want of the proper ventilation of the sewers, and in no small degree to the escape of sewer-air into dwellings when forced out of them by the recurring influx of surface-waters, to say nothing of the escape of diluted sewage into the basements of houses, and into the ground adjacent to the sewers, which too frequently occurs when the sewers are overcharged.

When systematic sewerage was first adopted, under the Public Health Act, 1848, there existed no law compelling the Local Authorities to free the discharged liquid of foul and noxious matter. The rivers were then still recognized as the proper recipients of liquid refuse, and whether it consisted of the water consumed by the population, and converted into sewage, or the rainfall thrown off the surface, it made no difference. The admission of suface-waters into sewers was therefore encouraged; first, because it was the readiest means of getting rid of a troublesome matter; and next, because the rain was thought to be the readiest means of flushing out the sewers. To make the sewers large enough to receive and discharge surface-waters as well as sewage, was represented as cheaper than the separation of the two; and so long as the rivers remained legally the proper recipients of foul as well as clean water, this treatment obtained general concurrence.

The obligation subsequently imposed upon all Local Authorities to free the refuse liquid they discharge into rivers from all foul and noxious matter has entirely upset this convenient arrangement, and we now find that, on all grounds, the separation of rainfall from sewage (as far as practicable) is desirable on Sanitary as well as economical grounds.

Of course, there will always exist flaws in both masons' and plumbers' work, however vigilant the supervision of local surveyors may be, and faulty traps will be found to admit sewer-air into dwellings and leaky sewers to let out liquid into the ground without

any extra pressure, caused by the influx of surface-waters; but every day's experience is proving, to those observant of facts, that on occasions of heavy rainfall, not only will sewer-gas find ingress into dwellings through faulty traps, but it will make a passage for itself, through water-traps, into kitchens and sculleries, even though they be in ordinary working condition. It not unfrequently happens, too, that upon extreme occasions, sewage diluted with storm-water will rise up the private sewers into the cellars and basements of houses; and I have seen instances where the deposit of sewer sludge in cellars has been considerable, and the effluvium arising from it most objectionable. All outlet pipes from sinks, &c. ought to be disconnected from the sewer, and then these evils cannot arise.

In the disposal of sewage, the advantage of separation is incontrovertible. This was made very clear in 1868, by the late Mr. William Menzies, and has since been forcibly shown to be the case, by Colonel Jones, as well as several other authorities on sewage utilization. As a sewage farmer, having to deal with different characters of soil, more or less absorbent, I can speak feelingly upon the immense difficulty of dealing with sudden augmentations of quantity.

But it matters not whether sewage is utilized upon land, or its solid ingredients precipitated by chemical processes, the sudden and copious increase of quantity, and the equally sudden and great variation in quality, will always convert the best designed arrangement into a work of disorder.

If, in addition to these drawbacks, the sewage has to be raised to the place of disposal, it is needless to say that every gallon of surface-water by which it is diluted, adds proportionately to the cost of pumping.

The only objection that in any way holds good is that the sudden admission of the rainfall into the sewers is an automatic mode of flushing them, and relieving them of deposit. But when it is remembered that surface-waters invariably bring with them road detritus, it will be granted that in the majority of cases the sewers are more likely to gain deposit than be freed from it by the admission.

Without going into any details to show that methodical flushing is superior to the occasional clearing of sewers by the rainfall, I am content to state, that with properly devised penstocks and valves, engineers may effect a perfect means of flushing sewers of deposit without the aid of the rainfall; though, in saying this, I would not reject the partial use of surface-waters, when they can favourably be brought to bear.

III. The ventilation of the public sewers of a district is the next object upon which I desire to express my opinions.

Engineers are constantly meeting with objections from the Local Boards they serve, from inhabitants of sewered towns, and not unfrequently from medical men, to the existence of ventilators, *i.e.*, the manholes and lampholes with gratings acting as such, when placed in the streets and other thoroughfares; and a medical

journal, of high standing, recently pointed out that invalids, and persons of weak constitutions may inhale effluvia coming up from these outlets with very injurious results. These objections often assume, too, a substantial form by the outlets themselves being stopped up. We shall admit that a disagreeable stench meeting us as we pass a ventilator in the street, is not an agreeable thing, and we may readily conceive that a person sensitive from sickness might suffer from such cause: but, inasmuch as gases generated in sewers must escape somewhere, there can be no doubt but that it is far better that they should do so in the public streets and in the open air, rather than in private houses and confined spaces, from which there is no escape.

The problem to be solved is, how to effect such a system of ventilation as shall prevent the escape of objectionable stenches, either into the streets or into houses. Tall shafts, erected in selected places, have been tried, and are found incapable of effecting that concentration of foul air that was expected of them, while all attempts to purify gases rising up from street ventilation by the interposition of trays of charcoal, or any other material, have been found equally ineffective.

But the difficulties we experience are, nevertheless, to be overcome; not by adopting extraordinary scientific expedients, nor by reducing the number of outlets, or stopping up those that exist, but by increasing their number, and by insisting upon the ventilation of the soil-pipes of water-closets connected with the sewers, and all receptacles of putrescible matter into which sink-pipes, &c., may discharge, by sufficiently large pipes carried directly up above the roofs of houses.

Experience on all hands points to the advantage of diffusing the air of sewers by frequent ventilation at different elevations. This alone secures perfection. I, therefore, submit that a positive understanding should be come to, which should have the force of law.

IV. The next and last question I have to submit is, "Should all sewers be made watertight?" Upon this point it is quite as necessary for the public advantage that a positive rule should be laid down, as it is to come to a final decision on those objects which I have already put before you.

Although, as an abstract question, there can be no doubt that sewers should only discharge the foul liquid they collect, it cannot be denied that, in certain instances, sewers which have acted as drains, in consequence of their not having been constructed in a watertight condition, have produced such a good effect upon the health of the district they have traversed, by reducing the water-level in the ground, that a conflict of opinion has arisen, and to some extent still prevails, as to the desirability of having conduits, which shall perform the two services of sewerage and drainage at the same time. The adoption of what has been termed "drain-sewers," however, in the cases I have referred to, was not the result of deliberate design, but was due to the absence of a recognition of the actual difference between a drain and a sewer, the duty of the

former being to drain water out of the ground, while that of the latter is simply to discharge, as I have said, the filthy liquid it is intended to collect. These "drain-sewers" were, in fact, constructed with a disregard of the truth, that the same apertures which admit water into the sewer from the surrounding ground, under one condition of things, will let the filthy liquid out of the sewers into the same ground, to make it excrement-sodden under another condition of things.

If the effect of making a sewer act as a drain was simply to lower the water level in the soil, and secure the benefit which, in a Sanitary view, invariably follows the lowering of the subsoil-water in a populous town, nothing could be more desirable. But the consequence of doing so may not only be what I have just pointed out, but it will certainly be to dilute the sewage to such an extent as to increase its volume beyond the limits of economical treatment.

Within certain limits this dilution acts beneficially in keeping the sewers clean, but where, as in Liverpool, London, Dover, Leicester, and Torquay, the constant outflow from the sewers is more than doubled by the influx of subsoil-water, the difficulties of disposing of sewage is very greatly increased.

The difference between the admission of subsoil-water and surface-waters is, that the former increases the outflow, and the cost of treating that outflow constantly, while the effect of the latter is only occasional. In the first case, the whole of the outflow, however much it may be diluted, must be freed of foul and noxious matter; whereas, in the last case, relief may fairly be afforded by storm overflows, in times of heavy rainfall, when the rivers themselves are in a flooded and disturbed condition. Two evils, therefore, attend the use of sewers as drains, which may be avoided by making them watertight.

I am led to submit this point for public consideration, because it is not an unfrequent practice, in certain localities, to use clay for the jointing of sewer-pipes, under the plea of economy. In some parts of the north of England clay is more frequently used than any other material; and I have good reason for knowing that, although, in certain instances, that practice may be adopted without much disadvantage, in the majority of cases, it entirely fails, both in keeping the subsoil-water out of the sewer, and the "sewage proper" in the sewer. So difficult is it in the first place to prepare clay suitable for the purpose, in the next to get it placed equally within the socket, and afterwards to retain the jointing in its position, under pressure from without, when the soil is full of water, and under pressure from within when the sewer is overcharged with the rainfall, that I do not hesitate to say, after more than thirty years' continuous practice in the treatment of clay, that no amount of vigilance in supervision can render clay a perfect material for the jointing of sewers of any considerable length. I have, on several occasions, found that after a time the clay has been entirely washed from the joint.

With the facility that always exists of placing a subsoil open

drain upon a watertight sewer, to keep the subsoil-water well below it during its construction, as well as to serve for a discharge of that water for all future time, it is hard to find a reason for uniting the two works in one.

The practice which now finds favour with our leading engineers, of jointing sewer-pipes with tarred hemp, or gaskin, and Portland cement, and having an independent drain beneath, with a layer of concrete between them, to support the sewer where it is of large dimensions, seems to leave nothing to be desired. I, therefore, submit that all sewers should be watertight.

Believing that the Government will not take upon itself to determine such questions as I have put before you, I would ask, is it not desirable that some seven or nine selected men should, with the approval of Parliament, form a Sanitary Council or Commission, somewhat of the character of the Railway Commission, who should consider and express a positive decision, when unanimous, upon all such points as may be deemed of national importance, so that Local Authorities may be assured that they are proceeding safely in the works they are required to execute?

BAILEY DENTON, C.E.

The Dangers of Bad Plumbing.

DURING the Exhibition which was held in Leamington in 1877, I contributed some remarkable specimens of mal-construction in plumbing, and also some curious examples of leaden pipes into which holes had been gnawed by rats while seeking ingress to a house. I also showed several pieces of sheet lead which had been completely perforated by worms that had previously destroyed the unseasoned roof boarding underneath. In the present Exhibition I have laid upon a table some still more remarkable examples of defective and dangerous plumbing; and I may add that each specimen which I exhibit has been associated with death and disaster in some shape or other. In the few remarks which I will now proceed to make, I will endeavour to classify under the heads of Imperfect Jointing and Improper Treatment of Wastes, the sources of some of the evils complained of, so that each specimen may point its moral.

IMPERFECT JOINTING.

These faults will mostly be found in soil-pipes. For instance, there is a slip-joint, properly so called, in which one portion of the soil-pipe has simply been dropped into another, without any filling-up material or solder. A necessary result of this is that the sewer-gas escapes at all times into the house, when the soil-pipe has to be erected in the interior of the house in the ordinary wall chases. Even when the soil-pipe had been

led outside the house I have come across notable examples in which the sewer-air has escaped from these open joints, and found an entrance into the house by way of the open windows. Cases of death due to this improper delivery of soil are very common indeed, and the victims are mostly servants who sleep in attics, the windows of which open above these pipes. Sometimes, even when the joints have been properly made with solder, but when the soil-pipes inside the house have been insufficiently tacked to the wall or insufficiently supported, the weight of the soil-pipe has sufficed, by dragging action, to open the joints, with the usual bad consequences. It is not an uncommon occurrence to lay bare soil-pipe joints which have been made with putty, and tied over with canvas; or red-lead joints, without the slightest attempt at soldering; and when these joints were dry, an open annular seam has appeared, which has allowed an exit for the sewer-air. Joints of this description are almost invariably found in the older class of houses, and I have exhibited, on several occasions, pieces of soil-pipe, not more than 2 ft. in length, upon which could be noticed each one of these samples of improper jointing. I need hardly say that faults of this kind are mainly attributable to the carelessness of the workman, who has been content with the worst of patching, instead of insisting upon an entire replacement of the worn-out pipe, as was his duty. I am only too well aware that very often the builder has orders from the owner to carry out the very cheapest repairs; but this ought not to be a valid excuse, because it is neither workmanlike nor businesslike to treat so serious a matter as a soil-pipe in this way, and he ought to know very well that a soil-pipe cannot fulfil its duty properly unless it can sustain a column of water inside without trickling at the joints; and when the builder observes, upon taking down the casing, that a pipe has become eaten into holes by sewer-air, or abnormally thin, he should know that no amount of patching he can devise will remedy the defects, seen and unseen, in such a case.

The corrosion of soil-pipes into holes is almost entirely due to the action of sewer-gas, and will always be found present in some portion or other of an old soil-pipe which has never been ventilated. Where disinfectants of certain kinds are freely used, the decay of the lead is greatly accelerated. When a soil-pipe of this description is laid bare, the safest way is at once to remove it, and to replace it by a drawn lead soil-pipe of proper thickness, duly ventilated by a continuation of the same diameter of pipe up to the roof, remote as possible from windows and chimneys.

There is another thing which a builder has a perfect right to refuse to do, and that is to lead the soil from a water-closet into a rain-water pipe which descends inside the house, or has its extremity near any window. This is a very frequent cause of illness, even when such a rain-water-pipe, made to do double duty, is led outside the house; as, for the most part, it will be found that the upper extremity delivers foul air perilously near the inmates. During the past year I have known cases of death traced to this very fault. The evil factor in such improper treatment is multiplied when the pipe has not been made of lead, but only of lengths of thin cast-iron

down-pipe, which cannot properly be jointed or made air-tight. I say that no responsible builder should ever consent to the erection of such inadequate soil-piping, or only upon the specification of an architect or engineer who dare risk it under certain conditions. Nor ought any one to make use of an iron soil-pipe outside the house, unless it be thoroughly disconnected at the foot, and a current of fresh air thus continually passed through it.

IMPROPER DELIVERIES OF WASTES.

A very large percentage of the waste-pipes of sinks are led direct into the drain, with only a bell-trap inside the room, which is oftener than otherwise broken, or with its upper portion removed for the convenience of passing down, quicker than is needful, the pantry and other sink wastes. As a result of this, and especially in butler's rooms, where he perforce sleeps, in order to be close to the strong room, a regular highway for foul air is established into the rooms, bringing with it sicknesses of many kinds. It is the same, too often, with housekeepers' rooms and servants' halls, in which sinks have been placed, and servants who are often obliged to pass the greater part of the day in such rooms suffer in consequence. The only remedy against this state of things is to cause the sink to deliver over the trapping water of an open gully outside the house, no matter what distance the pipe may have to go to reach the exterior of the building, and to provide, as well, a trap underneath the sink itself, in order to keep out the cold air and the effluvium arising from the decomposing wastes in the gully. This latter is a point which is often overlooked.

The above state of things is sufficiently bad, especially in a large household, too profusely equipped with sinks in the basement; but it is, perhaps, nothing to be compared to the improper entries of housemaids' sinks into soil-pipes or D-traps of closets. In nearly every instance when a foul smell is discernible upstairs, it will be found to arise from this improper connection between these wastes and the soil system. I am not now speaking of properly constructed housemaids' sinks, with ventilated traps underneath, which are purposely constructed for the removal of bedchamber slops of all kinds, because these may be allowed in such cases to enter a properly ventilated soil-pipe; but I refer rather to sinks merely intended to remove away the drips from hot and cold water taps, in which case the danger is greatly enhanced by the sinks being placed in passages close to bedrooms and in proximity to the great air-shafts formed by the staircases. These kinds of sinks should invariably deliver in the open air, and may sometimes be conveniently and safely led to the upper head of a rain-water pipe.

Another disgraceful system which obtains in many houses, even of very modern construction, is the leading of the cistern-waste or overflow into the trap of a closet. I have this year exhibited some startling examples of this dangerous practice, and I must most earnestly call attention to the fact that drinking-water is contaminated in this way to an extent which must be incredible to any one who has not made the Sanitary inspection of houses his special

study. I have come to the conclusion that the wisest way to avoid the dangers consequent upon this improper treatment of a cistern-waste is to treat the latter as an overflow, and point it through the wall in all cases where a standing-waste cannot be led to deliver in the open air.

The few remarks which I have made upon the subject of the delivery of housemaids' sinks into the D-traps and P-traps of closets are equally applicable to the wastes and overflows of baths. An examination of my pilloried specimens will show that this practice is far too common. One can observe there the traps of closets, into one of which have been led the waste of a cistern supplying drinking and closet-flushing water, the waste of the housemaid's sink, and the waste and overflow of a bath. As may be observed there also, the wastes of baths, sinks, and cisterns have been taken into both cheeks of one D-trap. It is bad enough to place the bath in the same room as a closet, and I wonder how architects can persist in this evil association, but it is something horrible to think that the delivery of the bath-waste is into the very foulest conduit. And yet this latter mistake is one very constantly practised by plumbers who at least ought to know better, and who ought to feel themselves in a position to refuse to carry out such a practice, even if ordered to do so by a clerk of works. I have known instances in which death has entered a household by way of a bath-pipe thus dangerously connected, the danger being enhanced by the frequent contiguity of bath-rooms to bedrooms.

Nor can it be said that these errors of judgment, or worse, apply only to old houses, for I exhibit samples of closet-traps, with bath, cistern, and sink entries, which are palpably but lately from the plumber's hands. In the majority of cases the excuse cannot be urged that these mistakes have been perpetrated in order to save money or to scamp the workmanship, because many of these traps are really excellent specimens of skilled labour, and in some of them the wonder is how the painstaking workman could have brought his soldering-iron into play at the wiped joints in so small a space. The faults are entirely, in such instances, due to total ignorance of Sanitary principles, and to a slavish following out of the traditions of the workshop.

When we come to the water-closet itself, we are all bound to admit that there is a great deal still to be done in providing a faultless apparatus. Most horrible examples of death-dealing closets are to be found, especially in the area-vaults of our best town houses. I should, above all, like to see abolished the filthy D-trap, with its furrings of fæcal matter, the huge iron container, with its linings of ancient ordure, and the trap at the foot of the soil-pipe, with its excremental cess-pit. I would even like to see abolished all traps whatsoever to closets, and I am convinced that if plumbers would only follow the lead of our more advanced Sanitarians in this respect, or at least more largely patronize the earthenware closets, that much solid good and absence from disease would accrue to the community. It is almost criminal for builders still to persist in the use of the pan-closet, which, to my knowledge, was condemned by

Mr. Chadwick nearly forty years ago; and how they can insist on fixing this dangerous contrivance without a ventilating pipe, is more than I can fairly understand. I will not believe for a moment that its use is continued in order to sell the D-trap with it, the making of which occupies the time of the apprentices, or to provide for a regularly recurring bill of repairs; but those who persist in its use lay themselves open to the charge that they are introduced for no other purpose. I think the sole reason for the patronage it obtains is to be found in ignorance, and a false estimate of its economy and cheapness of erection. And I am persuaded that if our builders would only take to heart the lessons taught by the inspection of the much better articles seen at the present day in Sanitary exhibitions, they would refuse to have anything more to do with it.

There is another fault concomitant with the use of all closets, and that is the leading of the waste of the tray or safe under the apparatus into the closet-trap. It is almost invariably taken there in the commoner houses, and in a very large percentage also of the better class houses even yet, and one half the smells which encounter one on entering into a closet-room is due to this lamentable want of common sense and forethought in dealing with the closet essentials.

It is, perhaps, somewhat too much to expect that our tradesmen are all acquainted with the necessity for the disconnection of the house-drains from the sewer by means of any of the numerous disconnection traps, constructed on various systems, now in the market. But until such a trap is provided between the house and the sewer, at some part of the house-drain, the work has been only half done. Nor can there be obtained any absolute safeguard from sewer-air or house-drain gas, or any thorough ventilation of the horizontal drain or vertical pipes, until some method of absolute disconnection be practised, and fresh air taken in at such a trap in order to be discharged at the ventilating pipes. No plumber, however perfect his work, can hope to witness really satisfactory results from his labour until this disconnection has been achieved.

W. Eassie, c.e.

Mr. G. J. Symons asked: If sewer-gas is really so dangerous, why are men who work in sewers generally a healthy-looking class of men?

Professor F. de Chaumont being called upon by the President to reply, questioned the fact of the healthiness of sewer-men, and pointed out that evidence existed of the danger of sewer-gas, apart even from its forming a means of conveying specific poison. It was extremely dangerous in surgical diseases, rendering operations especially hazardous, unless special precautions were taken, giving rise to or aggravating child-bed diseases, erysipelas, ophthalmia, &c., and greatly increasing the danger of specific disease (syphilis). Dr. de C. had himself had occasion to see its influence in the production of ophthalmia in his own regiment. The evidence about sewer-men rested mainly on the statements of Parent-Duchâtelet in Paris, and on the state of health of the sewer-men of London.

P. Duchâtelet's statements are hardly borne out by his own statistics, for the number of men examined was small, and even they suffered from rheumatism, ophthalmia, fever, &c. As regards the sewer-men of London, they worked in large, well-ventilated sewers, where the sewage was largely diluted. He had not been in the London sewers, but he had taken a journey down the great sewer of Brussels, where there was hardly any perceptible smell to be noticed.

On the Effects of the Long-continued Application of Sewage Water to the same Land.

The subject of this Paper was suggested by an observation in the Report on Sewage Disposal of Messrs. Rawlinson and Read to the Local Government Board. The observation occurs in their remarks (p. 36) upon Sewage irrigation, and is as follows:—

"We have also been assured by a gentleman of vast experience that the long-continued application of town Sewage to the same land fails to produce the like beneficial effects as when it was first used."

To assign a reason for this ought not to be beyond the powers of agricultural chemists, and it is to be hoped that when their attention is called to it, they will not keep Sewage farmers long in waiting for the explanation and the remedy. The failure is a very important matter for agriculture, and affects also the condition of our rivers and streams. It is certainly a question which calls especially for the attention of an Association like ours, when holding its meeting on one of the "classic sites" of Sewage irrigation, and near the dwelling-place of one of its most bitter opponents.

But for these circumstances, indeed, the author would shrink from putting forward his opinions on a subject concerning which he can neither pretend to have a practical experience as a farmer, nor to a knowledge as an agricultural chemist which is satisfactory even to himself. At the same time he considers that he need make no apology in bringing before you for discussion the experiments and observations of eminent men bearing upon the question, and if he draws deductions from them which science will not justify, he will willingly submit to being corrected.

One of the latest experimenters on the subject of manures, who has published his results, is so far as the author knows, M. Ville, who directed the experimental farm, established at Vincennes by the Emperor Napoleon III, with a view to regulating the effects of vegetation by means of the elements which chemistry discovers in plants. M. Ville gives the results at which he arrived in a series of lectures which have lately been translated by Mr. Crookes, and the

work well merits the study of every intelligent farmer. It is on the facts and principles so clearly and simply put forward in this work that the author of the present Paper mainly relies for the support of his views, though additional evidence from the works of Liebig and Voelcker will not be wanting.

M. Ville found that wheat, when grown in calcined sand without any addition but distilled-water, acquired only a rudimentary development, the straw being hardly as large as a knitting needle. With 22 seeds of wheat weighing about 15 grains, a crop weighing somewhat over 90 grains was obtained. On adding the ten inorganic elements or mineral matters found in plants and without nitrogenous matter, the yield increased to 123 grains. With nitrogenous matter, but without mineral matter, it reached 138 grains. When lastly, both mineral and nitrogenous matters were added to the calcined sand the result was :—

" Almost magical. Previously the growths are languishing, precarious, and etiolated, but now the plants spring up rather than grow, the leaves are beautifully green, the stem straight and firm, terminating in an ear filled with good grains, and the heaviest weighed from 327 to 383 grains."

He concluded also from his experiments that one-half of the nitrogen required by the plant was derived from the air.

M. Ville next tried the results in calcined sand, with the suppression in turn of each one of the ten mineral elements which are found in plants. A fixed and invariable quantity of nitrogenous matter was mixed with the sand as a constant ingredient, and all the other elements were added by turns, omitting one each time.

1. When all the mineral ingredients, without any exception, were added to the calcined sand, to which the nitrogenous material (gelatine) had also been added, it was found that 22 wheat grains yielded prosperous plants which weighed 337 grains, and in some cases even 400 grains.

2. With the nitrogenous matter alone, omitting the minerals, the plants became miserable and stunted, but did not die.

3. When the phosphates were omitted, but all the other conditions remained as before, the plants sprang up and formed their first leaves, but these soon became yellow and withered, and the plants died. The yield, of course, being nothing.

M. Ville remarks upon these experiments :—

" We have proved that if the nitrogenous matter is retained, the plants become miserable and stunted, but they do not die. Death, on the contrary, invariably follows the addition of the mineral matter from which phosphates are excluded. This proves conclusively that the phosphates fill two distinct functions, viz., *they aid themselves in the nutriment of the plant, and determine the beneficial action of the other mineral ingredients.** Their function, therefore, is more important than that of the other mineral ingredients, since to their own peculiar action is added a secondary derived effect, that of determining the assimilation of all the other mineral ingredients."

* The italics are not in the original.

4. In the next experiment potash was excluded, and the stalk of the plant, instead of growing vertically, bent as if it wanted solidity. It did not die, but the yield scarcely reached 92 grains.

5. When magnesia was excluded the effects were nearly as disastrous as in the absence of potash. The yield fell to about 123 grains instead of 337.

6. The omission of *soluble* silica was very prejudicial to vegetable activity. From 337 grains the yield dwindled down to about 120.

7. The suppression of the lime produces a less sensible effect; the yield is then about 307 grains instead of 337.

Leaving the culture in calcined sand, Ville extended his investigations to various natural soils, and of these he says :—

"On submitting them to the same experimental system, we found that whatever might be their dissimilarity there was a distinct line of demarcation between the phenomena produced in them and those observed in the calcined sand; for to render vegetation flourishing in the latter material, a nitrogenous material and ten mineral ingredients were required, whilst in natural soil, however poor it might be, a nitrogenous ingredient and three mineral ingredients only—phosphoric acid, potash and lime—are sufficient. The yield is maintained at the same level as when sulphur, silica, soda, magnesia, iron, and chlorine are added."

"Experience shows, therefore, that the four ingredients—nitrogenous matter, phosphate, potash, and lime—are the only ones that need be admitted into manures."

"For myself, I never found any natural earths in which, with the help of these four substances, it was not possible to obtain a yield comparable to that obtained in the most favoured soils".

To the mixture of these four substances, M. Ville gives the name of "normal manure," but in so doing he does not intend to deny the utility of the other mineral ingredients. He excludes them from the manure simply because the soil is provided with them naturally.

In another series of experiments, undertaken to ascertain the action of humus, M. Ville found that with the help of all the mineral matter and a nitrogenous ingredient, the yield rose :—

In calcined sand	to 337	grains.
Sand and clay	,, 337	,,
Sand, clay, and limestone	,, 337	,,
Sand and humus	,, 337	,,
Sand, humus, and clay	,, 337	,,
Sand, humus, clay, and limestone ..	,, 475	,,

Humus, as is well known, originates in the actual substances of plants, being the result of a kind of spontaneous decomposition whereby a certain quantity of hydrogen and oxygen is lost in the form of water. It was originally considered as one of the most efficient of fertilizing agents, but though it is now recognized that this is not the case, it is found to exercise very good effects in the soil. An illustration of this fact is given in the above experiment

with limestone, clay, and sand, in which a great increase of crop is gained by the combined action of the humus and calcic carbonate. Humus absorbs oxygen from the air, and afterwards undergoes a slow, inappreciable but real combustion, with the formation in the soil of carbonic dioxide, which acts as a solvent of certain minerals, and especially of limestone and calcic phosphates. It, therefore, helps to supply to vegetables these ingredients in an available form. Humus, it may be mentioned, also fixes the ammonia in the soil, and thereby prevents it from being carried off by rains.

M. Ville subsequently inquires into the constitution and functions of farm-yard manure, and into the :—

"Connection between it and that law of restitution which we cannot escape from, and the disregard of which is fatal to the fertility of soil."

He finds it to consist—1st, of about 80 per cent. of water, which is certainly not the cause of its efficacy as manure; 2nd, of 13 per cent. of woody fibre (carbon, hydrogen and oxygen), in which the active principle of manure had previously been shown not to reside; 3rd, of 5 per cent. of the seven mineral ingredients which have been proved to be of very little value in a manure, because they exist in the worst lands; and 4th, of between $1\frac{1}{2}$ and 2 per cent. of a mixture of the four bodies—nitrogen, phosphoric acid, potash, and lime—of which chemical manure should consist. Although, however, the carbon, hydrogen and oxygen of the woody fibre of farm-yard manure and of the solid dejections it contains are very slightly active at first, such fibrous matter acquires great efficacy by the decomposition it undergoes when brought into contact with the air, resulting in the conversion of the nitrogen, present with them, into ammonia, and, as is the case with humus, rendering the mineral matters more soluble.

After a long course of exhaustive experiments, M. Ville shows that, with farm-yard manure alone, great crops are impossible, because the total amount of substances capable of being assimilated is never sufficient, *but if the ingredients required by each crop are added yearly, the highest results will soon be attained.* If these are omitted and farm-yard manure alone be used, the fertility of the soil will be more and more impaired.

"We know by experience that in giving to the soil the moiety of nitrogen contained in the crops the soil is not impoverished."

"With phosphoric acid it is not the same, the soil loses 7 lb. per acre, the grass land returns 7 lb., but when the loss by rains is determined, the proportion of phosphoric acid which passes into the state of ferric phosphate and aluminic phosphate, both of them inactive compounds, constitutes a real loss, the effect of which must, in the long run, be severely felt."

"It is true that the soil receives notably more potash and lime than it has lost, but by reason of the deficiency of nitrogen and phosphoric acid, the increase of these two products is of no avail. With farm-yard manure alone farming is fatally arrested at the outset. . . ."

"Farm-yard manure owes its value to the nitrogen, calcic phosphate, potash, and lime which it contains, and, as one of these substances is always subordinate or predominant as regards the three others, according to the kind of plants we are growing, the nitrogen, which is the dominant constituent in the case of wheat, descends to the rank of a subordinate agent in the case of leguminous plants; but, notwithstanding this change, it is a noteworthy fact, on which I cannot too strongly insist, that this predominancy only manifests itself on the express condition that the soil is provided, to a certain extent, with the other three constituents of a normal manure."

Liebig, in his "Laws of Husbandry," tells virtually the same story:—

"Every field contains a *maximum* of one or several, and a *minimum* of one or several other nutritive substances. It is by the *minimum* that the crops are governed, be it lime, potash, nitrogen, phosphoric acid, magnesia, or any other mineral constituent; it regulates and determines the amount or continuance of the crops."

"Only those ingredients of farm-yard manure which serve to supply an existing deficiency of one or two of the mineral constituents in a soil, act favourably in restoring the original fertility to a field exhausted by cultivation; all the other ingredients of the manure which the field contains in abundance are completely without effect."

"No special argument is needed to demonstrate that where a wheat soil contains just so much phosphoric acid and potash as will suffice to afford the quantity of these two substances required for a full wheat crop, and no more . . . . an increase of phosphoric acid alone has just as little influence in making the returns greater as an increase of potash alone."

"The error of using too much manure arises from the mistaken notion that the action of the manures is proportionate to the quantities in which they are applied; this is true up to a certain limit, but beyond this all the manure is simply thrown away as far as any fertilizing action is concerned."

"A fresh store of nutritive substances brought up from the deeper layers of the soil may possibly accumulate again in the arable surface soil, but these deeper layers also will be gradually exhausted, and the accumulated store in the arable surface soil will also be consumed. *This is the natural termination of cultivation by the system of farm-yard manure.*"

Nor are there any reasonable grounds for supposing that continued applications of town Sewage would be free from the law which holds good with farm-yard manure.

Farm-yard manure consists of the excreta of animals and decaying straw and vegetable remains. Town Sewage consists of the excreta of human beings and animals, mixed with grease, paper, and other decaying vegetable refuse.

The elements which give value to farm-yard manure are the same in kind as those which give value to town Sewage, but, as compared

with the phosphoric acid, the proportion of nitrogen is much greater in the Sewage. The potash and the lime, as well as the other ingredients, are in each case very variable, but on the whole the two manures may be regarded as not essentially differing in this respect. The carbo-hydrates, or woody fibre, bear a larger proportion to the nitrogen in farm-yard manure, but these play only a secondary part in vegetation, and as they are in a far more active condition in the town Sewage, probably the inequality in this respect is made up for. The grease in the Sewage has no fertilizing effect whatever. The great difference between the two forms of manure is in the quantity of water associated with them. Whereas, in farm-yard manure, it is from 80 to 85 per cent. of the whole, or about four parts of water to one of solid matter; in town Sewage it is from 2000 to 3000 to one of solid matter. Finally farm-yard manure need be applied only when crops require it, but town Sewage must be applied whether they want it or not, and during the periods when vegetation is inactive, many of the valuable salts are carried away in the drainage water. Dr. Voelcker has determined that although potash, nitrogen, and other salts are detained in the soil through which moderately strong solutions are filtered, the reverse action may take place when such dilute solutions as town Sewage are treated.

Now there is nothing in all this to encourage the hope that land under Sewage irrigation has its losses from cultivation more efficiently restored than if it had been manured with farm-yard manure. On the other hand there is much to excite the fear that the exhaustion will go on much more rapidly in this case than when farm-yard manure is employed. Sewage irrigation is most useful for the cultivation of grasses, and the growth of this class of plants being enormously increased by it, such crops must lead to the more speedy exhaustion of the minerals which especially feed them. In short, if, with farm-yard manure as our only fertilizer, we cannot dispense with the predominant element of each crop, much less can we do so with town Sewage alone.

This matter is so important that we will look at it in another aspect. It has been shown that there should subsist a certain relation between the phosphoric acid of a fertilizing compound and its nitrogen. Phosphoric acid is the element which, as we have seen, determines the action of all the other ingredients in manures. Without phosphoric acid plants die, but this is not the case if any other of the elements of plants be absent from the soil. The phosphoric acid, therefore, becomes the measure of the quantities of the other ingredients which it is useful to add to a manure for the growth of any particular crop. All supplies of such ingredients in excess of this, are of no avail, and will, in some cases, prove injurious.

For a general manure for agricultural and horticultural purposes, Dr. Voelcker is of opinion that the phosphoric acid should be to nitrogen in the ratio of about 100 to 50.

The mean of the six normal manures for different crops recommended by M. Ville gives the ratio of the phosphoric acid to the

nitrogen as 100 to 74, varying between 100 to 130 and 100 to 33, according to the nature of the crops.

In farm-yard manure the ratio is as 100 of phosphoric acid to 200 or 300 of nitrogen.

And in town Sewage as 100 of phosphoric acid to 600 or 700 of nitrogen.

We see, therefore, how large a proportion of the nitrogen of Sewage manure must inevitably be wasted under the present system, if the above agricultural chemists approximate even to the truth in their conclusions, as to the quantity of nitrogen, a given proportion of phosphoric acid in a manure will render assimilable. A larger supply of phosphoric acid than the Sewage will supply at the critical periods of the growth of crops, is the author believes, the most efficient remedy for all this. This may of course be supplied in the shape of super-phosphate, and when potash is the constituent demanded by the crop, the deposits of salts of potash discovered a few years ago in Prussia, will yield a cheap supply of it. The calcic sulphate which would be added to the manure by the super-phosphate would of course supply any want of lime which might arise from the solvent action of the Sewage water upon the lime in the soil; and the lime deposit, where lime is used in the precipitation of Sewage, will, in conjunction with the decomposing organic matter of the sludge, afford a large supply of lime when lime is wanting in the soil. By the judicious application in fact of phosphoric acid, potash, and lime, dependent on the nature of the crop, no exhaustion of the land through Sewage irrigation need be feared. Indeed as far as phosphoric acid and lime are concerned, this addition may be made to facilitate greatly the disposal of that bugbear of all who are concerned with Sewage, viz., sludge. To dry sludge is, as it is well known, a formidable operation, and it becomes almost a hopeless task, unless mineral substances are abundantly mixed with it. The addition, however, of so much inert matter as is generally employed for the purpose, renders the sludge, by degradation, of so low a manurial value that it will not bear the cost of carriage. The author, however, has proved, by means of experiments conducted upon a large scale, that a comparatively small percentage of lime and phosphoric acid, not only renders the sludge less retentive of water and more easy to filter and dry, but it deprives it also, to a great extent, of its noxious smell.

It may be objected that to make phosphoric acid soluble and then to precipitate it, and again deprive it of its solubility by lime, is a waste of acid which must render the plan impracticable; but the author submits that this view has already been shown in this paper to be erroneous. Such calcic phosphate as is soluble to a scarcely appreciable extent in ordinary water, becomes fairly soluble when attacked by water in which carbonic dioxide is dissolved, and such carbonic dioxide must result from the decomposition of the carbo-hydrates which the organic matters of the sludge abundantly provide. Calcic phosphate is also dissolved by the ammoniacal salts which exist in Sewage water in sufficient quantities for the wants of

vegetation. For Sewage irrigation, indeed, precipitated phosphate and decaying organic matter are better than phosphoric acid in the perfectly soluble condition; for in the latter state there is more danger of its being rendered less assimilable by plants, by being too readily converted into its inert combinations with iron and alumina. There is also the still greater danger of its being washed away altogether in the drainage water. Dr. Voelcker found that in operating with very dilute solutions of phosphoric acid, the proportion of the acid which was left in the liquid after passing through the soil was just as large as it was before it was applied.

By supplementing, in the manner which has thus been described, the action of the Sewage water, and by treating Sewage sludge with phosphoric acid and lime to be used as a top dressing, not only would the manurial effects of the Sewage water, when employed in irrigation, be greatly increased, but its application to land both fertile and unfertile would, the author believes, continue for all time as beneficial as in the first few years of its use.

HENRY Y. D. SCOTT,
Major-General.

The Sanitation and Draining of Towns, and Disposal of Sewage.

THE Sanitation of a town, and the disposal of sewage without creating a nuisance, and without polluting either river or the sea, are admittedly subjects of national importance; and as all the means of effecting these objects that have hitherto been employed have been more or less failures, practically and financially, I venture to bring to the notice of the Sanitary Institute a novel process of my own which, as it is based on one of nature's immutable and essential laws, must certainly be right in theory, and cannot therefore be wrong in practice, if properly carried out.

I start then with this assumption, that what the HEART, or, as I call it, the PUMPING STATION of the body for eliminating and purifying the blood, is to man, such would SEWAGE WORKS properly constructed on the plan I propose be to the purifying and disposing of SEWAGE.

This may strike you as a strange idea, but I undertake to work it out to your satisfaction I think.

I lay it down, too, as a law not to be disputed that a town cannot be healthy unless it be clean; and in order to be clean it is necessary to do much more than simply carry to the outside land the excretions of men and animals.

If these propositions be true, it is just as essential to dispose effectually of discarded house refuse and scavenged material as it is to get rid of sewage, if we wish to prevent the occurrence of

disease from an accumulation of things that foster corruption and decay.

But the efforts of Sanitarians have hitherto been confined to the disposal of sewage. This in my opinion is only half doing what is necessary to be done.

If we examine minutely the articles that compose a midden, or an ordinary manure heap, we find amongst them seeds of numerous weeds and larvæ of coleopterous insects.

I contend that a great deal of injury is now being done to land by putting the contents of middens and house refuse in a crude state to fields and gardens.

Much of the good that manure is able to do is neutralized by such means, because a crop of weeds and a host of destructive insects are the certain result.

What is there, let me ask, that takes more from the profit of a farm than a crop of weeds ?

The labour to eradicate them thoroughly would be half the rent, and the loss on the corn crop as much.

If you ask me for evidence of the destructive power of insects, and the loss to society by growing weeds instead of food for man, I refer you to the daily experience of those who cultivate the soil—to occasional articles in the various journals—and other available sources of information. But no one proposes a permanent remedy.

I desire, therefore, to offer a remedy that cannot fail to be efficacious. For that purpose then I collect all refuse from houses and streets, such as bones, vegetable cuttings, cinders, ashes, manure from stables, cowsheds, slaughter-house offal, street sweepings, the droppings from birds, horses, and other animals, oyster shells, fish refuse, *clothes and bedding contaminated with contagious effluvium*—in fact, everything rejected from house, garden, and field, and subject them to combustion as a preliminary step to the sanitation of a town.

It is, as you know, the daily practice of certain local authorities in various towns to collect the discharges from men and animals in pails and middens.

But to do so, whether visibly to the eye or not, I say is a filthy and revolting process, fit only to be used by a primitive and barbarous people, in barbarous times, and is a disgrace to the civilization, refinement, and vaunted social progress of the present day.

Statistics of fever extending over two quinquennial periods from 1868 to 1877, given by a Medical Officer of Health at a Conference of the Society of Arts, were intended to show that pails are better than middens, but with what fractional benefit the figures themselves will prove.

In the first period up to 1872 there occurred in the town of Nottingham—a town not remarkable for cleanliness—748 cases of fever directly traceable to the pestilential influence of pails and middens. Of these 748 cases of fever 395 died.

This was with the "midden system prevailing." In the second period from 1873 to 1877 when "the pail-closet system prevailed,"

there were 549 cases of fever, and of these 256, or nearly one-half, again died.

Thus there were in all 1297 cases of fever, and of these no fewer than 651 died.

Such a state of things in a Sanitary point of view is to be lamented and wondered at, and whilst it is not at all complimentary to medical science, justifies the existence of such a society as a SANITARY INSTITUTE.

The Congress will no doubt have inferred that the mode of Sanitation which I urge upon them implies the existence of one or more WATER-CLOSETS in every house.

In fact I doubt if Sanitation will ever be much advanced till water-closets are universal, and all restrictions on the quantity of water supplied by companies are removed.

Assuming then that a town is drained by properly constructed sewers, and that water-closets are the mode by which excreta are discharged from houses to sewers, I come to the consideration of what means are best for the disposal and utilizing of sewage.

In the process invented by me, I have carefully abstained from the use of lime, or any chemical agent to effect precipitation, for the sufficient reason that lime is quite unnecessary.

Here I may observe that the precipitation of an article simply suspended in a fluid, as fimus is in sewage, is to all intents a mechanical, and not a chemical act. The active agent is gravitation.

It is then quite unnecessary to effect decomposition in order to precipitate fimus.

Therefore when sewage is collected in tanks, all that is required is to precipitate the feculence by a mechanical agent that will not only not destroy, but will add to the fertilizing character of the sewage, and at the same time absorb the superfluous moisture not otherwise disposed of.

The article I employ is finely pulverized calcined ash obtained from the combustion of the bones, house refuse, and scavenged matter spoken of before.

According to the size of the town to be drained, and the quantity of sewage formed, I construct a series of four, five, or six tanks.

Or one tank could be made, in an oblong form, sufficiently large to be divided vertically into six compartments.

Each of these would communicate with the adjoining division, about two feet from the top.

On the top of tanks Nos. 1 and 2 a furnace is built, large enough to contain several cartloads of refuse, and into this furnace everything that comes under the name of scavenging is placed to undergo combustion.

The furnace in which the combustion is effected being immediately over the tank, the finely calcined ashes fall through the floor of the furnace to the sewage below, and thus become the mechanical agent to produce precipitation.

When tank No. 1 is sufficiently filled, the sewage from the OUTFALL PIPE is diverted to No. 2, there to undergo the same process of precipitation.

Then, when deposition has proceeded to some extent in the first tank, the more or less clear supernatant fluid is drawn or let off into tank No. 3, to allow the finer portion of the suspended *debris* to deposit itself there.

But ashes will continue to fall or be deposited from the furnace to the first tank till any moisture that may remain has been absorbed.

The mass will then be stirred and assimilated by a mixer, or revolving wheel, till it is dry enough to be removed in sacks or carts. This is simple enough.

Here I may state that the outfall sewer pipe is made to enter the tanks a short distance below the floor of the furnace, which is composed of iron bars so closely put together that only the finest material can pass through.

From the furnace upward there will necessarily be a current of air, and as Nature never permits a vacuum to exist, it happens as an absolute result that any foul air or gas that may arise from the tank, or be attracted to it from the outfall pipe underneath the furnace, must pass to the fire and be there destroyed.

Having, as just stated, precipitated the solid part of the sewage, and passed the remaining fluid from one tank to another till everything suspended in it has become deposited, and the fluid clear and limpid, we come next to the mode of disposing of the effluent.

In order, therefore, to dispose of the effluent usefully, profitably, and to the permanent benefit of a town, I erect on the top of tanks Nos. 5 and 6 a capacious reservoir or cistern to receive the effluent, as shown on the plan.

Into that cistern I pump the effluent from the tank or tanks below by manual, steam, horse, or other power.

Then from the reservoir or cistern, as shown on the plan, I pass the effluent by gravitation through a pipe, tube, or channel running parallel with the outlying sewers, but on a higher level, by branches from the main to holes, or inlets, made at, or near to, the crown of the sewer.

The effluent thus made to pass into the sewers by a concentrated descending force, or fall, of perhaps four, five, or six feet descent, effectually agitates and stirs the sewage.

This mode of agitating and moving the sewage is, as you will see, a self-performing and continuous act, carried on simply by gravitation, without manual labour or assistance of any kind, and by it the sewers become thoroughly washed.

Thus the contents of the sewers are passed on by a steadily persisting, uninterrupted stream to the outfall pipe and tank again, partly by gradient descent, and partly by the *vis a tergo* force imparted to the sewage by the energy with which the effluent descends to the sewers.

The sewage then undergoes the same process of precipitation and purification as had been performed before.

Just then as the HEART, OR PUMPING STATION of man's body, sends the blood to the various and distant parts of the body by arteries or

channels, and brings it back by the veins of the heart again, to be purified by the lungs, so does the arrangement of SEWERS, SINKS, and CISTERN circulate and purify sewage, and eliminate from it its poisonous parts.

The deleterious part of sewage, as you all know, is the gas that is produced and emanates from it.

But decomposition of sewage cannot occur, and gas consequently cannot be formed, unless sewage is at rest or stagnant.

Every wine-maker, every brewer, every chemist knows that rest is essential to produce fermentation in wort and must. So it is with sewage. At rest it ferments; kept in motion it does not.

But if from perversity of thought, or want of comprehending the principles here laid down on which draining should be done, an engineer constructs his sewers with insufficient gradient, then I say his sewers will be no better than elongated cesspools.

But whatever the gradient of sewers may be, sewage should be kept in steady circulation as the blood of our bodies is.

Then with a continuous flow of effluent into the sewers, as I have just described, the production of sewer-gas will be prevented, and one of the potent causes of zymotic disease will be certainly frustrated.

It will thus be seen how impolitic it is to adopt wrong principles in draining and disposing of sewage, and how foolish and pernicious it is to rely for relief on that phantom of misapprehension and absurdity, the VENTILATION of SEWERS.

When sewer gas has been formed, I contend the proper thing to do is to retain the sewer-gas in the sewer—I say the natural and true place for sewer-gas is the sewer—and then, by creating a vacuum at the outfall pipe, the gas will be attracted there, and destroyed by combustion at the furnace I have described.

But to discharge sewer-gas into streets and houses by what is called "ventilation of sewers," is, in my opinion, one of the grossest misconceptions of true sanitation and common-sense that it is possible to commit.

Yet certain Sanitary Authorities commit this mischievous act every day, and are unable to comprehend that disease and death can come as the result.

If you will allow me, I should like to mention one more point of importance before I conclude.

At given distances along the pipe that conveys the effluent from the cistern to the sewers, hydrants should be placed.

Anything like an overflow, or excess of effluent, would thus be prevented.

From those hydrants water could be drawn as necessity required to water streets and roads—in many cases to the saving of large sums to the rates.

From these hydrants water could also be conveyed for the service of water-closets, for washing carriages and horses, and for garden use.

In case of fire, too, these hydrants would always be available adjuncts to extinguish it, and could be employed also for many other purposes.

You are aware, too, that at the Society of Arts and other learned societies, there have been frequent discussions on the possible deficiency of our NATIONAL WATER SUPPLY, and HIS ROYAL HIGHNESS THE PRINCE OF WALES initiated action on this important subject at the Society.

Well, now, surely it is a rule prudent people should adopt when the ordinary sources of supply of an article of necessity are likely to be deficient, to take care that the supply already possessed should be economized and used in a way to prevent future possible want.

If that be true, then I say it is a suggestion for good to dispose of purified effluent in the way I propose; for not only would such disposal add to our present national water supply, *by saving the consumption of water in ordinary use*, but, taking the aggregate of towns, would represent an amount of money saved to the rates that very few persons have imagined, extending no doubt to several millions a year.

It will probably be inferred that, taking the average of seasons and the general character of land, it will be better, cheaper, and more fertilizing to deprive sewage of its effluent before it is applied to the soil.

I grant that there are in the Eastern counties and other places, some loose textured soils, to which sewage may be applied at any time, for in its natural state sewage is undoubtedly an agent admirably adapted to renovate a poor and thirsty soil.

But such soils are the exception and not the rule.

Even on these soils great advantage must necessarily result to the cultivator by having an unspoiled, unadulterated, natural manure, equal to the best guano, ready prepared to apply to the land at any time, freed from the noxious power of generating weeds and deleterious insects.

For although plants cannot absorb manure in its solid and dry state, but must have that manure dissolved by rain or other means, it is impossible to apply crude sewage to land in any quantity in such a summer as this of 1879, if due regard is to be had to the sanitation of the district where sewage is so applied.

The larger the quantity of sewage in its crude state that is applied to land, the more must be the evaporation from that land.

Consequently, the greater the evaporation the greater must be the dissemination of noxious matter throughout the atmosphere of the district.

If that be not the case the character of sewage as a poisonous agent has been much maligned, and it cannot be hurtful.

But facts and experience prove the contrary.

To sum up, then, I would say that no mode of draining and utilizing sewage can be worthy of NATIONAL regard and acceptance unless it be able to dispose of sewage by turning every part of it to use and profit, without discharging anything into river or sea.

It must also be able to dispense with the application of crude sewage to land except under special circumstances; must be able to destroy sewer-gas—exclude it from houses and streets, than

which nothing is easier if right means be adopted; must also prevent the reproduction of sewer-gas, and by abstaining from spoiling sewage, keep the sewers clean.

No system of sanitation, I contend, will be worthy of national regard unless it can accomplish one and all of these things, and I am sure that the process I have patented can.

W. Hempson Denham,
SOC.COLL.CHIR., S.F.M., F.L.S., F.S.S., M.S.A.

A paper was read for Captain Liernur, in which he explained his system and his own views upon sewage disposal at considerable length. The paper is too long to iusert in full; we must therefore confine our notice to the discussion which followed.

Mr. Donaldson expressed his surprise that the system of Liernur still found advocates in England. That system was not in reality a system for collecting and disposing of the whole of the polluted matter of an inhabited area, but a system for collecting only those ingredients which were richest in material value for the purpose of making a manure called *poudrette*. The inventor now called his system the double conduit system. The one conduit is the cast-iron pneumatic tube; the other is a gravitating sewer, discharging the whole of its contents directly into the nearest stream. Everything calculated to make the manufacture of *poudrette* difficult and costly is to be excluded from the pneumatic conduit and sent away by the gravitating sewer. Amongst the polluting liquids to be sent directly into the river, Captain Liernur himself enumerates the following:

(*a*) Manufactory water, cleaned by those who soiled it;

(*b*) Kitchen water deprived of all suspended matter;

(*c*) Bath and household water (minus sleeping-room wash water and fæcal matter) in its natural uncleansed condition.

That is to say, every manufacturer must successfully purify all his liquid filth on his own premises; and every drop of household filth, including soapsuds, with the exception of housemaids' slops and fæcal matter, is to be discharged directly into the river!! Such a system can never be adopted by any town in Great Britain and Ireland.

Financially speaking, the cost of Liernur's double conduit system is more than double that of a duplicate gravitating system in which the rainfall only is admitted into one set of sewers where the natural features of the ground are favourable, and is also in all cases more than double the cost of a duplicate system of sewers when the sewers proper are designed in accordance with the principles of Shone's ejector system. Captain Liernur states that the cost of the whole of the works at Amsterdam for collecting the sewage has averaged about 24*s* per linear yard of street. The *poudrette* works, nearly finished, will add 6*s* per yard more, or together 30*s* per linear yard of street for the pneumatic system. His estimate for the second conduit, 20*s* a yard, seems high, but as this sewer has to convey all household slops, it must be laid deep enough to

drain cellars, and must be of the same lengths as the streets. If Stone's ejector system achieves success, which Mr. Donaldson is confident it cannot fail to do, nothing larger than a 9-inch pipe will be required, and the sewers, replete with every modern scientific requirement for ventilation and flushing, can be built for 10*s* a yard. In a scheme prepared by Mr. Shone and himself for the drainage of Cambridge, recently submitted to the Commissioners of that town, the estimated cost of the ejectors, mains for air and for conveying the sewage outside the limits of the borough, engines, air-compressors, and buildings, was a little under £16,000, which in the case of Cambridge is about 8*s* per head of the population, and about 6*s* per yard of street. As rain water only is to be conveyed in the most direct way into the nearest outlet, the sewers for this object will be shallow, and their length probably not more than two-thirds the total length of the streets; so that 6*s* per yard of street will be an ample estimate, including cost of gullies. A duplicate set of sewers, designed in accordance with Shone's system, would therefore cost about 22*s* per yard of street. Captain Liernur's estimate for his own duplicate system is 50*s*.

W. C. Sillar, of Blackheath, said that it was difficult to separate the agricultural from the Sanitary aspect of sewage treatment, and that seemed to be the reason why the manurial value entered so largely into the discussions of this Institute.

There was, or ought to be, no doubt that sewage contained great agricultural value; and evidently it was only carrying out the intentions of nature in giving back to the land that which the land had first given to us.

It seemed to be needless to enlarge upon the products of a sewage farm. Shame upon them if they did not produce marvellous results, considering that they applied to a few acres the manurial wealth that ought to serve to enrich many hundreds. Still the difficulty seemed to remain of preserving in a proper form the sewage deposit without injuring it.

It seemed to be an accepted fact that sewage treatment could not be made to pay. That might be, but there was no reason why the sale of the deposit might not greatly reduce the working expenses; but this would depend upon the fact whether or not there was a market for the manure.

Anticipating that this question would be brought before the Institute, Mr. Sillar said he had taken the trouble to write to the manager of the Sewage Works at Aylesbury, asking how much of the sewage deposit of that town remained on hand now—after the three or four years that the treatment of the sewage had been carried on—and he had received the following reply:—

Sewage Works, Aylesbury,
October 22, 1879.

Dear Sir,—In answer to your inquiry I beg to inform you that at present we have no native guano in stock, our orders having

entirely cleared us out; and I may mention that we have orders in hand for all we can make up to the end of April next.

Yours faithfully,
(*Signed*) W. STEVENS, *Secretary*.

One fact was worth more than much theory, and this letter proved not only that there was sale for the manure, but that it would bear, and bear well, the expense of carriage to a distance; a fact stoutly denied by many sewage authorities. And, moreover, it would be interesting to know, that this manure was largely sent abroad, not only to the vineyards of France and Italy, but to the coffee plantations of Ceylon. Indeed, the report of its efficacy in arresting the ravages of phylloxera among the vines was most remarkable, and, although it was premature to say that it was an infallible remedy, all the evidence received as yet was encouraging, though a second year's experience in confirmation was desirable. Whether this is received or not, there can be no doubt that the manure bears not only agricultural value, but very high agricultural value, and this may be verified by any one interested in the subject by a trial on any scale, from a single flower-pot to a large farm; and whilst on this subject he might say that whatever value was in it was from its own intrinsic qualities, and not directly or indirectly from any addition of fertilizing matter.

He submitted that the works at Aylesbury were a practical solution of the problem, and open to the inspection of any inquiry; and there, where the sewage was being treated day and night continuously, without offence of any kind, the value and character of the resulting manure was not only a practical solution to a great difficulty connected with agricultural depression, but also a solution to at least one-half of the Sanitary question.

On Heating and Ventilating.

THIS paper advocated a method of heating buildings by bringing in air at a high temperature through a large opening about seven feet from the floor. Immediate diffusion under such circumstances was said to take place, so that thermometers placed in various parts of the air-space read the same, irrespective of distance from the source of heat. The foul air was proposed to be taken out by openings near the floor (on the *supposition* that it was rendered heavier by vitiation) and carried up by tubes in the walls and the roof, and then discharged.

C. HENDERSON.

Observations upon Effective Ventilation.

A HOUSE-DWELLING should afford us shelter from wind and rain, and, while enabling us to obtain a comfortable temperature, should not deprive us of pure air for breathing.

The ordinary house-dwelling certainly provides us with shelter, but the requisite temperature, and the pure air, are obtained wastefully and with life-lowering insufficiency.

The warming and ventilation of buildings is an intrinsically difficult subject, requiring unusual thoroughness and comprehensiveness in experiment. An illustration of the danger proceeding from the neglect of strict experimental investigation was afforded by the very general misconception with regard to the work performed by cowls in ventilation, which prevailed, until the President of this Section, with his colleagues upon the Ventilation Committee, published the results of their experiments at Kew. It is to be hoped that the very great public benefit, conferred by that investigation, will not be limited to the dispersion of the unfounded pretensions of the cowl supporters, but that it will inspire an attitude of sceptical inquiry towards ventilating appliances, in general.

Perhaps, also, a lack of precision in language has contributed to obstruct our progress.

I may mention the word "draught" as an instance of this. In the popular sense of the word, a draught means a stream of air of highly uncomfortable and dangerous quality, and generally we find the effect of movement in the air and the impression derived from its quality are confounded one with the other!

Air perfectly at rest—stagnant air—though its quality may be good, is not agreeable to us, and perhaps not healthy. Mere movement in good air is agreeable and stimulating; fanning is so. Thus, in ventilation, a current or draught is distinctly an object to be attained, but of course the draught must consist of pure air, agreeable in temperature and in other qualities.

It will be prudent for me in order to secure a meaning identical in your minds and in mine for the loose expression, "the ventilation of houses," that I should at the outset explain my own understanding of it; I will, therefore, define the ventilation of houses to be *the maintenance of the atmosphere of a dwelling in that condition of purity, temperature, movement, and moisture which is found to be most agreeable to its inhabitants, and most conducive to their health and vigour.*

I think this definition is sound, although it goes beyond the limited sense in which the word is usually employed. The many modes of ventilating at present practised may, I think, be classified as belonging to three fairly distinct principles.

1st. We have ventilation by the natural or spontaneous method, or, as I prefer to call it, ventilation by the EXTERIOR WIND AGENCY.

2nd. We have ventilation by the operation of gravity obtained in ventilation by HEAT AGENCY.

3rd. We have ventilation by mechanical appliances, as blowers, fans, or pumps, which may be described as MECHANICAL AGENCY.

Ventilation, dependent upon the EXTERIOR WIND AGENCY principle, is the form commonly employed for the introduction of fresh air into house-dwellings in this country. The appliances for it are various in character. Among them are very numerous contrivances

applied to holes in walls of buildings. To this principle also belongs the introduction of fresh air by tubes which convey it into the interior of dwellings in a manner to cause the least annoyance and discomfort. Tubes for extracting air open at the top, or surmounted by a cowl, whether used in conjunction with some mode for admitting exterior air or not, must also be placed in this class.

I am well aware that in many of these contrivances the action claimed for them as proceeding by their operation, from difference in temperature between interior and exterior air, does take effect to some extent, but such action is altogether inconsiderable when compared with the influence exerted by the exterior wind currents to which the tubes are exposed.

It is one object of my paper to ask your earnest consideration as to the value and expediency of relying at all upon the force of natural wind currents for a supply of air for breathing purposes, and it would be a great step in advance to acquire clear views upon the merit of this form of ventilation.

A leading cowl manufacturer in his prospectus says that the wind has an average velocity of 10 miles an hour in this country—it is easy to calculate an average, but to be of use for ventilation that average speed should have a reasonably enduring continuance, it should represent a normal condition of the wind force—the wind in this country actually varies from about 1 to 30 miles per hour, however seldom such extremes may be touched.

For the ventilation of sewers, cellars, and for what I can best describe as *air-cleansing work*, the fitful, but from time to time, powerful and thorough sweeping obtained from the full force of an exterior wind current, is most valuable; but our respiratory process is regular and uniform, and something like a corresponding uniformity in the quantity and quality of the air supplied to our dwellings is required by us. If this be conceded, I submit that the admission of the force of wind currents is pernicious, and must frustrate the attainment of reliable and uniform ventilation.

Ventilation on the second principle, by Heat Agency, is a great improvement on that obtained by exterior wind agency; but if applied to extracting air by chimney draughts, the admission of air is usually allowed to depend upon appliances largely controlled by external wind currents.

In summer the plan of propelling air by heat ventilation cannot well be carried out, and the stoves devised for it usually operate at that season of the year upon the external wind agency principle with its inaction during the hot calms of summer, and excessive action when the natural leakage of our houses introduces air enough.

I believe it is by the employment of the third principle, that of Mechanical Agency, that we can alone become masters of the situation—able to introduce air at any required rate, and, at the same time, do very much towards raising its life-sustaining value. By the use of fans, blowers, or pumps, the quantity of air admitted is placed under easy and immediate control, and its

condition can be modified so as to bring it to a near approximation with any desired standard. As the object I had in view when commencing some modest experimentation, was *to obtain the means of introducing air suitable for respiration, and of regulating the supply of it at will*, I have concentrated my attention on the modes of employing mechanical agency.

To furnish power for blowing or pumping air into large buildings is simple enough; but its application to the needs of private dwellings in a manner sufficiently simple, automatic, and inexpensive, is surrounded with considerable difficulty.

The ordinary means for the application of power appeared incapable of furnishing a flow of energy in a form sufficiently attenuated for a machine required to do work as undeviating, and as constant as the process of respiration within ourselves. The descent of heavy weights, governed by clock-work movement, affords an arrangement by which a considerable amount of energy can be stored and liberated with uniformity at any desired rate.

A descending weight of one ton might run in a shaft by the side of a house from the top to the bottom or from the basement downwards in a tube to any convenient depth, or by combining the two, a vertical fall of many feet would be obtained. The weight could be raised by multiplying pulleys by hand power, or by any form of engine, steam, wind, hot air or gas, but by using gas or hot air engines, it would probable not be difficult to contrive some continuous automatic arrangement for starting the engine to wind up the weight. I have made trials in ventilation by using the fall of a weight (2 cwt.) descending 30 ft. in connection with a small fan blower for the ventilation of a room, and I have also tried by means of the same machine the ventilation of a number of enclosed spaces representing in arrangement the rooms of a house, A mode by which power of a similar nature could be obtained might be devised by employing two cylinders of capacity sufficient to give the required force, running over pulleys, made to fill automatically with water at the highest cistern of the house, and to empty themselves into a lower cistern. The two cylinders would rise and fall alternately so as to offer a continuous exertion of power.

My results so far have been encouraging, but I am sorry to say that they are not as yet in a form which I could conveniently lay before the Section, though I hope upon a future occasion to place some definite results before the Sanitary Institute. A plan has been patented by Messrs. Verity and Co. in which a very small stream of water from a cistern at the top of a dwelling-house, or direct from the Water Company's mains, gives motion to one or more blowers. Wherever water is available, and the amount of ventilation required is small, this plan is exceedingly convenient and inexpensive.

Hot-air engines and gas engines are now manufactured for machinists of a power low enough to enable them to be employed to give direct motion to a fan or blower without the aid of any intermediary. By using hot-air engines heated by gas a considerable, down to a very small, exertion of power can be obtained,

which, with some precautions, may be expected to act with the permanent and regular motion absolutely necessary in any arrangement for house ventilation.

After giving a good deal of consideration to the subject, and working at it in various ways by experiment, I came to the conclusion that we should not shrink from endeavouring to grasp, for an application to domestic buildings, the teaching afforded by the results of the best examples of ventilation in this country, such as the Houses of Parliament for instance. In short, that opportunities presented by a thorough and completely controllable system of air circulation should be utilized to the utmost, aiming at more than a mere replacement of breathed by unbreathed air.

Pure air united to the climatic conditions most agreeable and desirable for us is what is wanted. One process should enable us, in winter time, to secure a summer-like condition of air, as well as to maintain a high standard of purity in it throughout the whole of our dwellings.

Nothing but long habit could reconcile us to the extraordinary barbarism of the present ordinary provision for house heating. In each room we have a small patch of heat and a large space of cold, so that the arrangement of the dinner table and how to sit at work in one's study become problems it is impossible to solve; but such riddles are less serious than the important household question as to what condition or period of life, or what infirmity in health, constitutes a valid claim for the indulgence of a fire in the bedroom. The air of half our rooms is that of a cross between the atmosphere of a marsh and a glacier, and many of us leave a warm drawing room to undress and sleep and dress in the morning during winter under circumstances of pain and peril. Our houses surely cost us money enough to build or to rent, why should we not keep the whole of them in a habitable condition?

The labour, much of it of a very heavy and disagreeable kind, necessary for the average number of fires required in a large house is probably equal in the aggregate to the time and care which would suffice to produce with the proper appliances, any desired climatic condition throughout an entire house; and though the amount of attention required to carry out warming and ventilation in the form I contemplate may be too considerable for application separately to small houses, *why could not such houses, if built in rows or very near together, be supplied with pure air and summer climate from one source, taking precautions to prevent the loss of heat by the employment of non-conducting coats for the main pipes.*

The important item of saving effected by the avoidance of the destruction caused by stoves and open fires to the furniture, carpets, and hangings, must not be left out of consideration.

In point of original cost it is probable that the numerous stoves, with all their attendant paraphernalia of mantel-pieces, fenders, hearths, &c., in a house of twenty rooms, would cost as much in the first instance as the machinery for heating and ventilating, while in planning new buildings the arrangements for such a form of ventilation would not add materially to their cost.

I intend to apply these views to some buildings of different requirements I am about to erect. My endeavour will be firstly directed toward means by which the air used for circulation shall be endowed with qualities which will make those buildings comfortable and healthy at all seasons. The air will enter freely into a large chamber in which the whole of the appliances for heating the air, moistening it to obtain an agreeable dew-point, filtering it from dirt and blacks, and finally despatching it, by means of a blower or other mode, at any desired speed, will be carried on.

The details of arrangement for the circulation of air are, in some respects, those already well known, but in others they are of a special character. Great precaution is necessary to avoid any risk of injury to the quality or agreeableness of the air from the mode of heating it; but a chief cause of the difference experienced in the quality of air heated in various ways will commonly be found to be attributable to a neglect of its dew-point.

In conclusion, I submit that in experiment in ventilation we should keep in view, as desirable of attainment, the following:—

1. That the force of the current, the rate of supply, and quantity of air supplied for the purposes of ventilation of dwellings must be entirely under control.

2. That the quality of all the air supplied for ventilation of dwellings should be capable of easy approximation to any condition of temperature and moisture deemed desirable at any season of the year.

3. That greater influence should be exerted upon the circulation of air in dwellings by the apparatus for procuring inflow than by the means for outflow of air.

H. C. Stephens.

Ventilation: Position of Inlets and Outlets.

My object in introducing this subject, which is of the greatest importance if we want perfect ventilation, is that we may have brought before us such facts as are necessary for arriving at a right conclusion on this point.

In the first place, let us see what it is we desire to do. The products of respiration are of such a poisonous character that it is absolutely necessary that they should be allowed to pass away; then we have a certain amount of moisture and organic matter given off from the human frame which, when inhaled, has a most depressing effect upon us; and lastly, there are the products of combustion from lamps, gas, and other sources. The object of ventilation is to get rid of these, and to supply in their place pure air for our further support; for without this fresh supply man would be unable to perform his daily work.

Now these products have all one feature in common: they have all been warmed, and are consequently lighter than the atmospheric air which we wish to introduce and which tends, in consequence of its greater weight, to press them upwards.

This fact alone points out the natural and most economical method of proceeding.

Besides what I have just named there is another class of products which demands our most careful consideration at the present time, and which it would not be wise for us as Sanitarians to overlook. I refer to the volatile emanations met with in hospital wards, especially those set apart for infectious diseases; it is most desirable that these germs of disease should be carried away as speedily as possible, and with the least opportunity of contaminating the air of the rest of the room, and more particularly that which has yet to be breathed.—*See* Dr. R. Angus Smith ("Air and Rain," pp 491 and 492).

I think it must be clear to all thoughtful minds that the top of a room is the proper place for the outlet; this has been practically acknowledged, the difference of opinion varying more on the position of the inlets. The general objection to introducing air at the bottom of an apartment is the draught which has to be encountered. There have been many ingenious methods devised to overcome this difficulty, or rather to shirk it by endeavouring to obtain the same result by a roundabout process; they consist of various contrivances for admitting the air either at the windows, the sides of the room, or at the top; in every case above the breathing point, and with an expectation that the air would become diffused before reaching the people below. The objections which it must be plain apply to all these systems of introducing fresh air above the breathing point are these:—

1st. The diffusion is not always complete, the air often coming down in one column, to the inconvenience of those beneath.

2nd. When the air is admitted near the outlet, it is apt to be drawn out at once with the vitiated air; it may cause a little circulation at the top of the room, but leaves the bottom part nearly stagnant.

3rd. (And this I consider of the utmost importance.) The incoming air while becoming diffused with the air of the room is in reality undergoing a mixing process with the vitiated air which is ascending from the occupants, so that you cannot in this case obtain *pure air*, but a mixture of *pure* and *vitiated.*

In a room where you can admit a very large quantity of air at about the same temperature, this is not objectionable (except in hospitals, where in no case should the air be admitted above the beds, when it is intended to carry it away at a higher level), but this method becomes a very expensive one when the air, as in winter, is of a much lower temperature, and it is desirable to ventilate a room with the least quantity of air possible.

My investigations and experience have led me to the conclusion that the air can be admitted in ordinary cases at the bottom of the room, below the line of respiration, and that without the slightest

inconvenience. This I believe to be the natural system and certainly the most economical, as well as being the one which gives the most satisfactory results.

During the last winter, which was an exceedingly severe one, I introduced air directly into a number of rooms by the skirting, having cone-shaped openings. These were not supplied with valves, so that in no case were they closed, neither was the air warmed by warming apparatus, and yet it did not attract attention or elicit the least complaint.

If the current of air be reduced in its velocity by being duly regulated, or, what is better, by the shape of the openings, which cause it to be quickly diffused, then it can be admitted at a much lower temperature than is otherwise practical. This may even be carried to the extent of it entering at freezing point, as I have proved for weeks together, without experiencing any unpleasant movement. Further, the air at this position may be readily warmed by hot water or steam pipes placed in front of the openings, without that dryness which is felt when it is passed through a heated chamber.

J. E. Ellison.

Sir Antonio Brady next gave some explanations of how his house is provided with warm air.

Dr. de Chaumont mentioned that the bricks with conical openings, described by Mr. Ellison, had been placed in the wards of the General Lying-in Hospital, York Road, Lambeth, under the supervision of Mr. Eassie, c.e., and himself. The plan seemed to promise well as a means of renewing air without draught and introducing it in the proper part of the room—viz., below. Sufficiently high temperature would have to be provided by hot water pipes over which the entering air would pass; at the same time these openings would, like any others, be subject to the effects of wind, and might become outlets if they happened to be to leeward.

The President said that the plan of introducing warm air by means of the kitchen was good for small houses, and was suggested by Mr. Tredgold, but thought it could not apply so well to large houses. He then called for a vote of thanks to Mr. Ellison; who, in reply, stated that he did not object to the fresh air being admitted into a room above the breathing line when you could afford to introduce a large quantity of air at about the same temperature, though this arrangement has the objection that the fresh air becomes contaminated by diffusing with the vitiated air at the higher part of the room; but in cold weather, when it was not desirable to admit more air than was strictly necessary, the best result was obtained when it was introduced at the bottom of the room, and the vitiated air allowed to make its egress at the ceiling. This was most in accordance with natural law, and therefore the method which, when possible, should in all cases be adopted.

The President made some remarks showing that the best means of ventilating buildings is a very difficult problem, and suggested

a plan for introducing fresh air under the floor to the grate, and so warmed before entering the room. On the whole, the President agreed with Mr. Ellison.

On the Necessity for an Improved System of Ventilating, Heating and Cooling Crowded Human Habitations or Places of Assembly; especially in Hot Seasons or Climates.

Illustrated by an example in the shape of detailed plans of a Model Barracks.

Epitome.

The first half of this paper is devoted to showing up the mistakes made by architects pretending to understand the "Exhaust System," as they phrase it; yet everywhere making air-passages that do not exhaust foul air, but contrariwise admit fresh air, too often when and where it is not wanted and far above the necessities of the case.

The last half is simply a statement of the leading points of the internal arrangements for heating, cooling, and ventilating, as seen on inspection of the plans.

[The plans were exhibited and described].

John Balbirnie, m.a., m.d.
Member of the Council of the University of Glasgow.

Dr. Balbirnie's paper was illustrated by a numerous set of diagrams, but time would not allow of an explanation of them all.

At the end of his paper, the Chairman called upon Dr. de Chaumont, who spoke at some length, and pointed out many difficulties in constructing barracks on the plans suggested by Dr. Balbirnie. He paid a tribute of praise to the great care and labour bestowed upon the subject by the author, as shown by the elaborate diagrams he exhibited. He evidently had the improvements of barracks, hospitals, schools, &c. very much at heart, and had worked at the subject with enthusiasm. At the same time, Dr. de Chaumont did not think that the plans proposed would accomplish the desired end. It was a return to the construction of vast palatial buildings which experience had shown were both very expensive and also unadvisable in a Sanitary point of view. This was especially the case in the tropics, where the health of troops had been found to be greatly improved by scattering the

force in small buildings over a wide area. The arrangements of the individual rooms in Dr. Balbirnie's plans were objectionable, as they were side by side opening off a corridor. This resembled the arrangements of the permanent barracks at Aldershot, which Dr. de Chaumont had himself shown to be unfavourable for ventilation; it also resembled the mode of construction of Netley Hospital, the disadvantages of which he had daily opportunity of observing. Dr. Balbirnie's plan of ventilation, consisting as it did of an exhaust shaft, something on the plan of Sir J. Jebb as employed in Pentonville Prison, was one which could not be recommended. Dr. de Chaumont had practically tested the ventilation at Pentonville, and had found the result not satisfactory: the cells near the shaft were moderately well ventilated, whilst those further off were less so, and at the end of a wing the influence was practically *nil*. At present, independent ventilation for each room was apparently the best for barracks, and is undoubtedly essential for hospitals, the principle of whose ventilation ought to be the complete independence of each separate ward.

The CHAIRMAN then called for a vote of thanks to DR. BALBIRNIE; which he acknowledged, and replied to the remarks of Dr. de Chaumont, contending that the barracks he had proposed were in all their Sanitary arrangements, ventilation, heating of rooms in cold climates, and cooling them in hot countries, based on and in strict conformity with scientific principles enunciated by a Committee of Hygiene appointed in Paris for the service of the hospitals—that barracks implied and required precisely the same Sanitary conditions. The grand factor of a perfect ventilation was an "exhaust" chimney, or *aspiration* maintained by heat of fire or gas jets in the *cheminée d'appel*. That architects in England had but very partially turned their attention to this; and scientific men were prejudiced against it—entirely without foundation. The day would come that his plans of barracks, Board school, and hospital would be hailed as an immense improvement in all respects over the best buildings of the sort ever yet constructed.

The Necessity for a Permanent Registration of House Drains.

THE efforts of all who appreciate and promote the great branch of our art termed "Preventive Medicine" are directed towards creating throughout the length and breadth of the land a *systematic control* over all agencies and means known to generate or spread diseases which ought not to exist. The lower and middle classes have yet to learn to identify these diseases as results from their own infringement of nature's laws; but in this assembly no demonstration is needed to justify the assertion that for conveying

from house to house, and consequently spreading from individual to individual, some of the most to be dreaded diseases, no agency is more powerful than defective sewers or house drains. Being so potent for evil they rank as one of the most important parts of a dwelling-house, and it follows that the aim of Sanitarians should be directed, not alone to secure a high degree of perfection in construction, but to provide means for *subsequent supervision.* Admirable as are the regulations of the Local Government Act, it stops short of this latter point; it provides that plans of all new buildings must be submitted to the vestry or local authority; these after discussion by committee are further examined by the district surveyor; if he approves, the work is inspected, passed, and there supervision and record ends; the building when erected changes hands, possibly half-a-dozen times in as many years, and all remembrance of the course and position of the main drain is lost.

No need may arise for inquiry on this point till possibly sickness invades the house, sickness of such a type as to cause the medical man to inquire, "Can there be anything wrong with the drains of this house?" "Can there be any defect of construction, or is there any weak point which the time elapsed since the building was erected has developed?" The extent of information obtainable is in many cases reached by the master of house replying, "Oh, I don't think there can be anything wrong; I was assured by my predecessor all was perfectly right." But *where* does the house drain run? *Aye, where?* does it pass *under* the house? down the garden into the main sewer in front? or into the drain of the neighbour's house on the right, or that on the left? Cannot tell! Where are the plans of the house? Gone the way of all plans; nothing for it but dig, root, and explore in the most probable position, to the great detriment of garden, pleasure grounds, or such like.

Now this is not as it should be. The health of a house depends on the drains being pure; they must, from the nature of things, be hidden from sight; they will at some time or other require to be opened, therefore there should be a *permanent record* of their position, corrected at any time of change or alteration. The machinery for this is at hand. The plan to be effected *must be compulsory!* It is, that the local authority, vestry or board provide and keep up a *permanent register* of all drains, pipes, and channels of communication between a building and the sewer into which it drains. When the district surveyor approves the plan of a new building, he should append his signature to it, and this plan should then be inserted into a book, with a proper index, and retained for reference in the office of the local authority; half a dozen lithographed copies of this official plan should be handed to the owner of the property, and he should be required to affix one of these copies to the lease, agreement, or whatever form of document conveyed possession of the building to another.

By this means the owner of a house could at any time subsequent to the erection, ascertain without difficulty the exact position of the drains, and know precisely where to direct operations for examination of the same.

But not alone would it benefit one in possession, in the event of seeking to dispose of a dwelling-house, what an advantage for a hesitating purchaser! Unquestionably he would much prefer accepting one with which he received a certified copy of the drainage scheme, and on which he might obtain the opinion of a competent Sanitary engineer. Again, in the case of an epidemic invading a district, and necessity arising for a Government inquiry, what an immense assistance it would be if the commissioner or board of inquiry could have placed before them certified plans of the drainage of every house in the district under examination.

It may be objected that if this proposition were carried out, great space would be required to lodge all the documents; that as there are about forty thousand houses and warehouses erected annually in London district alone, these plans accumulating annually would be cumbersome. This is an objection which can carry little weight in comparison to the probable good. A central establishment might receive the records every five years, and the local officials keep outlines of same on Ordnance maps for daily reference. As to the outlay, it might be met by a slight fee for registration, and also for subsequent examinations, which fee might be increased according to the number of years elapsed since the first registration was received.

S. Parsons-Smith, M.K.Q.C.P., L.R.C.S.I.

SECTION III.

METEOROLOGY, GEOLOGY, AND GEOGRAPHY.

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METEOROLOGY, GEOLOGY, AND GEOGRAPHY.

The President of the Section, G. J. Symons, F.R.S. delivered the following Address:—

The title of the Section of Sanitary work to which we have to devote ourselves to-day, is one which naturally suggests an idea which I would not for a moment attribute to any one present, but which is, I believe, sufficiently general to be worthy of destruction.

The idea which needs demolition may be designated the worship of the practical. I have little doubt that the perusal of the programme of this Congress has led to some such remark as the following:—"Well, the first day devoted to Sanitary Science and Preventive Medicine, and the second to Engineering and Sanitary Construction will, no doubt, be very good; but what is the use of making three days of it, and having a lot of dry scientific papers of no use to anybody, and incomprehensible by any but dreadfully scientific people?"

This remark contains two errors—(1), The assumption that there is any difference or distinction between science and practice, except, perhaps, that science may be regarded as the teacher, and practice as the pupil; and (2), the assumption that scientific papers are beyond the ken of ordinary mortals.

As I have already said, I do not attribute this idea in its crude form to anyone here present; but I think that you will agree with me, that it is in one form or another sufficiently prevalent to render

it worth while to show that it is not merely wrong, but exactly the opposite of the truth.

I, therefore, purpose taking the branches of science mentioned on our programme, and pointing out some of the points of contact between these branches of science and Sanitary practice.

METEOROLOGY.

Let us take, first, temperature. Meteorologists can tell us the range of temperature to which we are liable in this country; but who will point to even one house so constructed as to resist equally well, extremes of heat and of cold? As regards the majority of houses, built solely in order to be sold, it is patent to everyone that this consideration is entirely neglected. The walls are so thin that they allow the internal temperature in summer to run up to eighty degrees or more, and in winter down far below freezing. There is rarely any outlet for the foul and heated air when it has found its way up the staircases; landlords never think of providing outside Venetian blinds, and the rooms which face the sun become veritable heat-traps. Everybody knows that foul and heated air ascends, and yet (owing to the rare adoption of French windows) nineteen-twentieths of all the rooms in England have no outlet within eighteen inches or two feet of the ceiling, where, consequently, there is a permanent stratum of foul and heated air; and, as if with a desire to aggravate this evil, a quantity of gas is burned in the rooms, and the deoxygenized air rises into this stratum, and remains there. Perhaps, if it were possible to compel every builder to remain for an hour with his head close to the ceiling of the rooms he built, an alteration would not be long deferred; unless, indeed, the foul air killed them all. Everybody knows all this, but few indeed are the cases in which any attempt is made to remedy the evil.

In cold seasons it is equally discreditable to hear on all sides complaints of the inconveniences arising from frozen water-pipes, and from their leakage when a thaw follows. If the temperature in England ran down to twenty or thirty degrees below zero, there would be some excuse for such occurrences, but our winters are never so severe.

This reminds me of another case in which a little meteorology would have saved several hundred pounds and much inconvenience. An engineer laid out the waterworks of an inland English town, and either from economy or want of experience, he put his mains

only one foot below the ground. He made no inquiries as to the temperature of the soil at that depth. A great frost came: the temperature at one foot went below thirty-two degrees, and so large a proportion of his pipes was burst that it was virtually a case of new mains throughout the town.

Another winter accompaniment which has occurred for hundreds of years is always a source of great confusion—I mean a heavy fall of snow. No one seems to know what is to be done, and the last idea is in many respects the worst. The tramway companies introduced the plan of scattering salt in order to dissolve the snow, and the owners of private houses have imitated them by scattering salt on the pathways in front of their houses. The result is, that the pavements are covered with rotten slush of an excessively low temperature, so cold as to lame dogs temporarily when passing over it, as to be injurious even to the well-shod, and almost unbearable to the shoeless wanderer. It would be very little trouble to sweep this soft slush into the gutters, and I think that any one using salt and not removing the resultant slush, should be not only *liable to* a small fine, but should infallibly *be fined.*

There is one subject upon which I am desirous of speaking somewhat strongly, but which is not exactly meteorological. It is, however, only a development of the remark which I have already made as to the absence of ventilation in the upper part of rooms. I will, therefore, mention it here. It is the terrible unhealthiness of our churches, theatres, and other places of public assembly. I am no chemist, or I would put before you the results of the analysis of the air in many public gatherings; but no figures are needed to prove what everybody knows. As regards churches, it is not for me to apportion the blame between ecclesiastical architects and churchwardens; but I cannot understand a preacher looking at the gradual drowsiness spreading over his congregation, and not reflecting that it is quite as much the natural result of poisoning by bad air, as of any lack of interest in his ministrations. I should not be at all surprised to learn that the opening of a few ventilators in the roofs of some of our churches was found to produce, not only more attention on the part of the congregation, but an increase in the amount of the collections; for keen interest in matters ecclesiastical is more probable when the mind and body are bright and vigorous, than when foul air has rendered the mind drowsy and made the head ache.

I am not prepared to say that all theatres are badly ventilated, and I have not much experience of the galleries, but I went once

into the top gallery of a building which we were told was to combine the good qualities of all such like edifices— I mean the New Opera House at Paris, and the heat and foulness of the compound which the audience had to breathe were such that I cannot understand any one going there a second time.

At more than one place of amusement a very rough-and-ready but effective cure for this evil has been adopted by constructing the roof upon a framework which can be rolled off so as to leave the audience roofless for a few minutes. I doubt, however, whether our medical friends would not consider such a remedy worse than the disease. I do not myself presume to advocate any mode of ventilation, but may perhaps be allowed to suggest the question, whether it is advisable to trust (as is at present generally done) wholly to the current generated by the difference in the specific gravity of fresh and effete air. There are two reasons for distrusting this mode of ensuring ventilation—first, in order to secure its greatest efficiency, the path of the inflowing air must be as free from friction as possible, and freedom from friction is too often co-existent with draughts; secondly, ventilation, depending on differences of temperature, or more strictly upon differences of specific gravity, is evidently least efficient in hot weather—the very time when the general public are most clamorous for an extra supply of pure air.

The head of a Glasgow engineering firm described to me an extremely simple arrangement whereby each successive two minutes 2000 cubic feet of air were extracted from close to the ceiling of an Edinburgh hall, noiselessly, and without either heat or ice. I do not at all suggest what ought to be done, but I hold that the foul state of the air in nearly all our public buildings is discreditable to the age in which we live.

A day or two after writing this part of my address a letter appeared in the *Times*, which was so extremely germane to my own remarks that I should like to read it to you.

THE VENTILATION OF THEATRES.

To the Editor of the Times.

Sir,—Now that we are upon the eve of another theatrical season, will you allow me to draw attention to a matter which has been broached in the *Times* not many months ago—I mean the ventilation of our London theatres. During the visit of the Comédie

Française, "A Physician" wrote to complain of the ventilation of the Gaiety Theatre, whereupon Mr. Hollingshead endeavoured to show that his theatre was fitted with abundant means for the exit of foul air. I attended two performances of the French players immediately after this, and suffered much from the atmosphere of the theatre; on the second occasion to such a degree, that I was obliged to leave after the first three acts of the play, which was *Ruy Blas*, thus missing the best part of the piece. But I do not wish to draw up an indictment against one theatre in particular, but against our London theatres generally, for I have experienced the same thing in most of them, even in such well-managed houses as the Lyceum and the Vaudeville. When I attended the inaugural performances of the Shakespeare Theatre at Stratford-on-Avon, last April, the contrast was very great, and there I found that sitting through one of Shakespeare's plays was attended with little more fatigue than sitting in one's drawing-room, simply because there were a number of excellent ventilators in the roof. I rejoice to see that Miss Litton has been attending to this matter in her theatre, and I feel sure that if you can find room for this letter it will induce other managers to put an end to an evil which is so injurious in its effects to the large and increasing body of theatre-goers.

I am, Sir, yours, &c.,

September 19. A REGULAR PLAYGOER.

Excuse this digression, and allow me to return to the more direct relations of meteorology with Sanitary matters. People of the *cui bono* class are, I believe, yearly becoming more rare, but there are thousands still who would doubt what possible use it could be to know how many miles of wind blew over Greenwich yesterday; and a still larger number would fail to see what possible bearing such a fact could have upon Sanitary matters. Mr. Haviland would tell us that both the direction and strength of the wind ought to be considered in laying out the plan of a town or of large additions to existing ones, and in the past, if not in the present, great care was taken that country residences were protected from objectionable winds by belts of trees. There is, however, a still closer connection, for the members will not have forgotten that this Institute is, and has been for a long time, conducting a series of experiments upon the effectiveness of several patterns of cowls, and that these experiments have been conducted with anemometers and air meters at the Meteorological Observatory at Kew.

Moreover, questions of ventilation, both for public buildings and

especially for hospitals, are almost wholly determined by means of small air meters, which are merely delicate anemometers.

Lastly, it is a rather curious fact that upon the summit of that modern Tower of Babel, the Queen Anne Mansions, Mr. Hankey has put an anemometer. I wish he would put another in the court-yard, and publish the records of both. Joking apart, I hold that if premises are to be carried to that height, the streets must be proportionately wider; for the air in a street of ordinary width, but with buildings of that height on each side, would scarcely ever be changed; its only purification would be by the passage of such portion of the rainfall as escaped falling against the houses. The notion of walking through a future London composed of streets of their present width, and houses as high as Mr. Hankey's, is the reverse of agreeable.

Take, again, ozone. I am not going into the chemical question, nor the strictly meteorological one; but in spite of all the demonstrations of the inutility and inaccuracy of the old-fashioned ozone test-papers, I think that they were giving us more useful information than we seem likely to obtain from the more scientific methods which have been declared to be alone of any use. We want some rough-and-ready test of the purity and healthiness of the air in different localities, but at present I know of none. The old-fashioned ozone test-papers had, doubtless, a multitude of faults—I have attacked them somewhat vigorously myself, and Dr. Cornelius Fox still more so; but unfortunately the arrangement which he proposed to substitute was so elaborate, that at the present moment I do not know of a single place in the whole of the British Isles where it is at work. Faith in the old plan has been shattered, and the new one has not been adopted. Perhaps it may be well to epitomize the old method and its faults, as it may lead some one to suggest a safe and simple course. And first, as to the method. Sheets of absorbent paper were dipped in a solution of iodide of potassium and starch, dried, cut into small strips, made into bundles, and sold in boxes. Observers were instructed to take one out each morning, hang it up in a place open to the air but shaded from light and of course from rain, and on the following morning to note the amount of discolouration by comparing it with a series of ten pattern-tints supplied with each box of papers; if there was no discolouration the entry was 0, if the paper was rendered quite a dark brown the entry was 10, and intermediate numbers for intermediate discolourations.

So much for the method; now for the faults. The discolouration

is effected by the contact of air with the paper; therefore, if on two days the amount of ozone in the air is the same, but the wind blows twice as strongly on one day as on the other day, it is obvious that the discolouration will also be double. This difficulty can be overcome in two ways—(1), by applying to the observed discolouration a correction corresponding with the total horizontal motion of the wind, as recorded by an anemometer placed near the end paper; or (2), by sheltering the test-paper from the wind and drawing a measured volume of air over the paper by an aspirator. The papers after exposure and colouration may, by the action of antozone or damp, be bleached before the usual hour of observation, and whereas 7 may have been reached some hours previously, at the regular observation hour the paper may only show 0 or 1. The late Dr. Lankester proposed to get over this difficulty, and also to determine the variation in the amount of ozone during the twenty-four hours, by using the paper in long strips, and winding it by clockwork from one drum to another under a small aperture. I do not think that he arranged his machinery with an intermittent motion, so that each portion should be exposed for some definite period—say, an hour, and then suddenly replaced by another portion, and so on, but that would obviously be the proper course.

There are many other imperfections charged against the old plan; but I will mention only two others. The papers were said not to be equally sensitive, and therefore the recorded discolourations were not strictly comparable. I believe that this ground of complaint arose chiefly from the very limited demand for the papers, and from the fact that there was so much jealousy among the opticians that, instead of all buying from one source, each tried to make his own. I have left the most serious charge to the last. Chemists of high position said that there was no certainty that the discolouration was in the least degree due to ozone, and, I believe, proved their case by tinting the papers by half-a-dozen processes when no ozone was present. Perhaps, however, we shall find that the papers give us useful information, even if they tell us nothing about ozone.

In this as well as other countries, the public attention given to scientific work is not proportional solely to the merit of the work, but is dependent on two factors: A, the social and scientific status of the worker; and B, the merit of the work. Meetings like the present tend greatly to diminish the value of the factor A, and I sincerely hope that before long it will vanish entirely, and leave the factor B the merit of the work, as its sole credential. You may wonder at the insertion of this digression; but it was induced by

my having resolved on now mentioning, for the first time, a few experiments which I made nearly five-and-twenty years ago.

I arranged with friends residing in various parts of the metropolis—one in the City, one at Whitehall, others at Chelsea, Notting Hill, Blackheath, Camden Town, and Camberwell—for three months' continuous observations of the amount of ozone. We took all the steps that we could to secure uniformity, even taking the precaution of cutting each ozone slip into portions so that all the stations used the same slip on the same day. At the end of the month the portions were returned to me and mounted as one slip for each day. That they in the least indicated the amount of ozone, I am not going to assert; but this I can safely say, that no matter from what direction the wind blew, the papers in that quadrant of the metropolis first reached by the wind were always more darkly tinted than those in the centre or in the opposite quadrant: those at the central stations were scarcely ever tinted. Similar results were, I believe, obtained by Mr. Glaisher during the cholera epidemic in 1854, and, though no special arrangements were made to ensure identity of paper, I do not think that the accuracy of the results was thereby vitiated. These very simple and inexpensive tests may be beneath the contempt of the optimists of ozone observers, but they at least prove that there is some quality in air coming from the country to the metropolis which is extracted, not only before passing over the whole of London, but even before passing over half of it, otherwise the central stations must sometimes have recorded traces of discolouration.

That there is a wide difference in the healthiness of different localities is indisputable, and that there is more in it than is revealed by either barometers, thermometers, hygrometers, rain gauges or weathercocks, is equally certain. Something may be learned by the chemical analysis of large volumes of air; something, indeed a good deal, is being learned at Paris by drawing a stream of air over glycerine and examining microscopically the particles of dust deposited. But we want something more handy. It is too bad that there should be no easy means of determining the relative life-supporting properties of the air in Hyde Park and Seven Dials. I do not for a moment say that the old-fashioned ozone papers will do it, but they are the nearest approach which has yet been made, and I should be very glad if they can be supplanted by something better.

Mists and Miasma.—Before proceeding to consider mists in

their relation to public health, I take one moment to say that if any of my hearers have ever seen in this country the presiding genius of mists—I mean the *ignis fatuus*, or "Will o' the Wisp," I shall be greatly obliged by their favouring me with full particulars. I only make this request because, in the course of long search, I have not met with one person who has seen it; and I am sure that, especially after the present soaking season, drainage operations will proceed so rapidly that future opportunities will be rare indeed.

Here, however, we are concerned with mists and their influence upon health. You doubtless remember the remark of the country doctor, who, walking up a hill, passed from the valley mist into the clear air on the hill-side, and turning to his companion, remarked that that white sheet covered all his best patients. I wish we had statistics of the mortality in some of our old monasteries—Fountains, Tintern or Rievaulx—for the localities are equally noticeable for their beauty and their mists; and although the regularity of the monastic life might conduce to longevity, I should have thought such damp localities very ill-adapted for such residents. It is often suggested that our ancestors were stronger than we are, and that, as much of their time was spent in the open air and in hunting, they were less susceptible to the Sanitary evils of their houses and castles. But the monks, even those who were not actually studious, did not lead by any means an equally active, open-air life. Were they, then, able to throw off the effects of damps and mists, or did they fall victims to them without knowing the cause? We, however, with all our nineteenth-century artificial and high-pressure life, know perfectly well that a "lovely spot embosomed in trees and encircled by hills," is usually characterized by a damp, misty, cold, and stagnant atmosphere. We know that these conditions are not adapted for vigorous health; and yet how many persons will rush blindfold into the arms of the doctor, simply for the sake of a pretty view! Persons generally select residences, and the sites for new ones, when the weather is fine and the sun shining. There is no reason for their discontinuing the practice; but many selections would, I think, be abandoned if an hour or two of the twilight and night were spent in examining the distribution of the mists in the locality. When we remember that few persons spend less than half their time indoors, it is surely not asking very much to urge that an hour or two should be devoted to examining roughly the conditions of the air which will in future surround them for half their lives.

You may think that I attach undue importance to mists, and

I will, therefore, give you a short chapter of personal history. A relative had a great desire to spend his autumn holiday in a beautiful, hilly, and well-wooded part of the south of England. Unable to obtain quarters on the high ground, he was induced to take a very clean little cottage on low ground; not, however, very near the river which ran through the little town. At first, four of the family went down, and three of them were speedily attacked with diarrhœa; another relative followed, and was similarly attacked; and finally I arrived myself. I was told of the state of affairs, and advised not to touch the water—on which all the blame was laid. The last train had left; and, moreover, I felt desirous of investigating the case. After dark we went out for a little stroll, and found the air excessively damp; in fact, there was a white sheet over the whole place. Next morning, I was as ill as the rest of the party. I had with me some permanganate of potash, and tested the water from two or three sources with it; but the colour remained absolutely unchanged; so I suppose there was not much the matter with the water. One of the party started off after a doctor; the doctor was out, but the assistant said directly, "Oh, no; it is not the water; strangers are almost always attacked like that; but they soon get better, or else they go away. You see," he added, "this valley is supposed to have been under sea water not long ago, and all the fields from here to the coast are terribly misty and agueish." I need hardly add that it was not many hours before the whole party migrated to a high, dry and sandy soil; but it was only by sleeping in the locality that the evil was incurred, and had we only seen the spot by daylight scarcely a suspicion of evil would have crossed anyone's mind.

Closely connected with the existence of mists is the amount of evaporation,—a subject upon which we are in nearly the same unsatisfactory condition as I have explained to exist respecting ozone. Some very elaborate, rather costly, and I believe extremely important observations upon this subject, were commenced more than ten years since, and have been conducted under the supervision of Mr. Rogers Field. We are still waiting for his full report on the subject, but it is understood that all the old forms of evaporator are useless, and no new pattern has been introduced in their place. The only two points of contact between evaporation data and Sanitary work which occur to me are—(1), that evaporation data would be serviceable in computing the yield of storage reservoirs, a point upon which I believe no information is published, and not much exists; (2), data as to the amount of evaporation would be

very useful in connection with sewage irrigation, for it ought evidently to be most successful where the air absorbs the largest amount of surplus moisture.

Hygrometry is almost identical with the measurement of evaporation, but not quite; because hygrometry considers the amount of moisture in the air at rest, and evaporation is the resultant of the passage of a variable number of miles of air of a variable hygrometric condition over a water surface. I am afraid this point is hardly clear: I will therefore put it in another form. The air we breathe is, you know, a compound; there is first an approximately constant quantity of oxygen, hydrogen, &c., and secondly a very variable quantity of water in the invisible state of vapour. It is the business of hygrometers to tell us how much water there is in the air. It is never very great, fifteen grains of water in a cubic foot of air is the extreme, perhaps a trifle beyond the extreme, which ever occurs in this country, while it may run down to one grain per cubic foot. The hotter the air is, the more water can it contain, and hence the high temperature always given to drying-rooms; and hence it follows that though a room may be dry while it is kept at a high temperature, it will very likely become damp when the temperature falls. A striking illustration of this is reported to have occurred at a ball in Russia. The night was cloudless and very cold, but the room in which the ball was being held was, as is usual in that country, close and hot. A lady fainted; and as fresh air could not easily be obtained, the windows being frozen fast, an officer broke the glass with his sword. The clear cold air rushed into the room and cooled that inside so rapidly, that the vapour became mist, the mist became frozen, and snow was formed in the room.

Some people err the other way, and especially in cases of illness; distress the invalids, and check their recovery by allowing the air to become too dry. I suppose matters may change in the next generation, but at present either a doctor or a nurse would be considered a pedant, who used a hygrometer in order to regulate the air breathed by a patient. I am glad to see that we are progressing in that respect. Two generations back the subject of the hygrometry of the sick-room was unknown. Twenty years ago, a paper spout on the nozzle of a tea-kettle was the most advanced apparatus, and now we have got as far as regular vaporizers; but I have not heard of any general demand for hygrometers to indicate when, and to what extent, vaporizers are to be used, and I fear that much is still left to the personal sensations of the medical attendant and the

nurse, although it is just as easy to order what shall be the hygrometric state of the sick room, as what shall be its temperature, and I think it probable that in many affections of the respiratory organs the former is of more consequence than the latter.

There is another matter in which hygrometry ought to come home to many, especially at a period when people seem so prone to forsake old and comfortable houses for new and showy ones. Almost before a house is finished, and long before the water necessarily used in its construction has had time to dry out, people rush in to reside, and then there are rumours of colds, rheumatics, &c., as if anything else could be expected in such a climate as that of the British Isles. I am not going to show how the hygrometer would enable people to adopt this course with impunity, but there are many ways in which it would teach them what to do, and what not to do. By-the-bye, there is a paragraph in Sir Edmund Beckett's treatise on "Clocks," which bears closely on the question of drying-rooms. He says—"The clock-room at the Exchange was at first made with the object of keeping out the dust and damp in every possible way: even the slits in the floor for the ropes had sliders to them; the clock was enclosed in a glass case, the plate glass cover originally placed over the escapement being found not enough to keep it from the damp. When the clock was repaired, and some of the brass-work replaced with iron in 1854, I suggested the removal of all this glass, and encouraging instead of preventing a draught through the room. This was done; and although the wet used to stand in drops upon the clock before in damp weather, it has been perfectly dry ever since. The same thing has been found in small clock-cases; they may easily be too air-tight. I do not mean that there is any objection to enclosing a clock in a case, and of course it is absolutely necessary when the clock-room cannot be kept locked against everybody but the man who has the care of it: only there should be a draught through the room, and the case itself not too close to let air through it."

Lastly, I come to the rain—and here the points of contact with everyday life and with Sanitary matters are so numerous that it is hard to know where to begin and harder still to know when to stop. Fortunately for us all, I need say very little to-day on the relation between rainfall and national water supply, because I stated fully my views upon that subject in my address upon Water Economy at your anniversary meeting; and it is for others either to refute my statements or to carry out the course suggested. Unfortunately there is another course, which is so easy that it is

generally preferred—I mean the ruinously costly one of *laissez faire.* The question of national water supply in its broad features is epitomized on page 21 of the address just mentioned, and the longer the time before action is taken, the greater will be both the confusion and the cost.

I leave the question of national water economy where I left it before: ripe for the action of our legislators.

The amount of rain is, I need hardly say, a most important element in all sewage questions; I say *all* advisedly, because even where attempts are made to exclude rain water from the sewers, no one claims to have succeeded perfectly, and even if he did, the rain question would very likely come in again as affecting the administration of a sewage farm.

By-the-bye, I trust that Mr. Rogers Field will try to apply his recent researches upon syphons to the flushing of drains by cumulative discharges of rain water.

The remarkable absence of some classes of disease during the period in 1879 when summer was expected to occur, may have been partly due to low temperature, partly to the absence of the usual supply of unwholesome fruit; but I think part must also be ascribed to the scouring of the streets and drains by the superabundant rains. And there is something else washed by the rain, greatly to the Sanitary advantage of residents in towns—I mean the air. Those who have leisure and inclination can follow this subject up by perusing Dr. Angus Smith's book on "Air and Rain." I will merely call attention to one proof of its important action, which is patent to everybody who uses his eyes—it is an almost invariable action, but I will take a strong though not overcoloured illustration. It is a summer evening, close and thundery, the air is thick partly with moisture but chiefly with extremely fine dust, particles of almost endless variety, fibres of cotton and of wool, soot, pollen from flowers, granite, road dirt, &c., &c. No thunder occurs, but there is a downrush of colder air: rain begins, and in an hour it is over, and has carried with it to the ground an enormous proportion of the miscellaneous compound which the inhabitants had previously been breathing. If you ask for proof of this, I merely refer you to the street-lamps; watch them regularly and you will find them nearly as good at revealing the dust motes in the air, as the beam of light from Professor Tyndall's lamp. Under the conditions I have described, they shine with a brilliancy rarely seen. Metropolitan air wants washing, it is wonderfully better for

the process, and I suspect that that is one reason for the low mortality in 1879.

Rain as a supply of drinking-water will be considered in one of the papers to-day; and in two or three others we shall have rain before us in its relation to the yield of wells. On those two points, therefore, I need say nothing.

GEOLOGY AND GEOGRAPHY.

In the programme of this meeting, Section III is stated to be devoted to Meteorology and Geology; but on the Congress tickets it is said to be for the consideration of papers Meteorological, Geological, and Geographical; which seems to me much better, for really the questions which we have to consider include all three branches of Physical Science. Perhaps we might include all under the single term Physical Geography, or, as I believe the South Kensington authorities now call it, Physiography.

Physical geography is the key to the, as yet, uninvestigated question of the true merits of our various health resorts. I am glad to state that I believe very shortly the Meteorological Society will have in operation a system of absolutely identical observations at a considerable number of these health resorts, and not limited to one station—in, for example, Brighton; for who would contend that the climate was identical on the racecourse and in Old Steyne? Years ago, Dr. Wigan wrote a little book on "Brighton, and its Three Climates," and the title expresses what probably exists more or less in nearly all our health resorts—and, Why? Solely because of the variations in the physical features of the locality—Hastings, Torquay, Llandudno, Tunbridge Wells. A moment's reflection respecting any of these places will convince you that in each you may find great climatic differences, precisely in accordance with the principles of Physical Geography.

As to the bearing of Geology on Sanitary matters, I think there is only one point upon which I need offer any remarks. The theory which I desire to submit will probably strike you as being wrong, if not ridiculous; it is this, a house on a clay soil is not necessarily more unhealthy than one on gravel. One great mistake in house-building, both in town and country, is in grudging a few courses of bricks, and so letting some of the rooms be at, or close to, the level of the soil. In isolated cases floors laid flat on the earth may be tolerably dry, but in the majority of cases they are not, and in no case can such floors be desirable for persons of delicate

health; and with reference to the relative merits of clay and of gravel, I would just submit two facts—(1), the clay under a well-drained house becomes so dry as to be almost dusty; and (2), although the probabilities are in favour of gravel becoming even drier than clay, yet should any offensive matter get into a bed of gravel, it would circulate more rapidly than in clay.

With reference to gravel and clay I may give one hint, based upon experience which I regret, but which may be useful to others, though it is another chapter of personal history.

Upwards of twenty years since, my father was suffering from consumption, and after two or three places had been tried, the physician and medical attendant advised that he should go to the upper part of Richmond, because it was high, it was away from the river, and on the gravel. A suitable house was found, and it was considered very satisfactory, because near to it some new houses were to be built, the foundations had been excavated, and all the removed soil was a fine gravel, The patient became rapidly worse, and after one or two consultations he was removed to Blackheath, where he speedily improved, and lived through a subsequent winter. Some time after taking the Richmond house, we found that the gravel was not only no advantage, but, as it appeared to us, the reverse, for there was a thin layer of gravel lying on a bed of clay, as was shortly proved by the foundations, which I have just mentioned, being found with several inches of stagnant water in them. All this is doubtless very obvious, but at any rate it may save others distress by warning them not to be satisfied with a merely superficial layer of gravel.

You will probably think it a strange omission on my part if I make no full reference to the relations between climate and disease, but, *Non omnia possumus omnes.* We cannot all do everything, and I can give you no newer, better, or clearer information than the world already possesses in the reports and papers of Dr. Farr, Dr. Simon, Dr. Scoresby-Jackson, Dr. Tripe, Dr. Mitchell, and Mr. Buchan; to say nothing of foreign and trans-atlantic investigators.

I should, however, like to say one word in behalf of the registration of disease, as distinguished from the registration of deaths. I do not believe that the general public, or even our legislators, understand clearly why experts are so desirous of obtaining a registration of disease in addition to that of deaths. To me it has always been mysterious that the records of deaths harmonize as well as they do with climatic data, for not only are half the deaths

of one week registered in the following week, but a far greater source of confusion lies in the fact that though certain climatic conditions give—say, fifty people bronchitis in one day, it by no means follows that they will all die on some one other day. If the death registers were filled up with rigorous accuracy, the entries might be posted back to the dates assigned for the commencement of disease, but I doubt whether the entries are accurate enough to justify the expenditure of the necessary labour, and moreover it is at the best a very roundabout way of doing it.

Why do we not get returns of disease? I am entirely ignorant of the secrets of the medical profession—(and parenthetically I may say that I believe it would be far better if there was less mystery about matters medical. I believe it would be far better to teach our youngsters what to eat, drink, and avoid, and some of the leading features of their own marvellous bodies, than the number of the satellites of Saturn or the exact sequence of the Palæozoic rocks. Excuse this digression.)

I can think of only two reasons for the absence of systematic disease registration. (1) That medical men in small practice are afraid of allowing it to be known how small is their list of patients. This surely could be got over in many ways; the records should go direct to the office of the Minister of Health (when we get one), and there they would be as safe as income-tax returns are after they get to Somerset House. And if even this would not satisfy nervous or fidgetty practitioners, they need not sign their returns at all. Let all blank forms issued from the office bear rotation numbers, and let them be booked to the medical man to whom they are supplied; none but the two or three officials in charge of these records could possibly ascertain who sent the report. I believe the objection to be absurd, but I have shown that it can be entirely overcome. Moreover, I am not sure that the actual number of cases is needed; I think it very likely that it would be more useful to record the percentage of all new illnesses due to each class of disease. The (2) ground of objection may be supposed to come from the man with a very large practice; he may say that he has not time for filling up any more returns. I wish those who are so situated would think of their younger professional brethren, and benefit themselves by helping others: but few people in any profession or business seem to be able to say, "I have enough now; I will let some one else have a turn."

But how are we to get returns from these people? I fear the only answer is by paying for them; for though I believe that many

of them love their work, and wear themselves out with their practice partly through that love, and though surely the majority of them would like to leave the world wiser and better for their having visited it; yet I fear there is no denying the fact that, unless a registration-fee sufficient to cover the cost of the dispenser's time in making up the return is offered by the Government, little progress will be made. I am sure that it would be a good investment of national money. For who will affirm that, in the future, disease signals may not be as usual as storm signals are now?

At the close of his address, the Chairman (Dr. Richardson) called upon Mr. A. Haviland to move a vote of thanks to Mr. Symons for his address; this was seconded by Dr. L. Marsh, and carried.

Dr. Richardson then spoke at some length, touching upon the principal topics raised in the address, and pointed out that hygrometric and temperature observations were taken at some hospitals. Dr. Richardson also announced that a Supplementary Section would be held on Saturday morning, the 25th October, for the reading of Dr. Balbirnie's and other papers which stood *over* from the previous Sections; and also that an Excursion to the North Surrey District Schools, at Anerley, would take place in the afternoon.—Dr. Richardson now resigned the chair to the President of the Section.

Mr. Symons thanked the meeting for their attention and for the manner in which they had received his address. With respect to the remarks of Dr. Richardson, he would confine himself to two points. Dr. Richardson had mentioned that at some of the hospitals hygrometric and other observations were taken, but the complaint which he had made was that the hygrometer was not used in ordinary private practice; and he had not yet met with an instance of that being done.

As regards the registration of disease and the alleged readiness to afford such information and desire on the part of the medical practitioners for the publication of such data, Mr. Symons felt doubtful, because the medical men of the United Kingdom were so numerous (about 18,000), and so influential that if they really wished for anything of the kind, they could bring such influence to bear upon Parliament as to obtain such a small matter without the slightest difficulty. As they did not take such steps, he feared that their interest in the subject was by no means so keen as that of the leading members of the profession.

Geology in relation to Sanitary Science.

It is a charming and recreative amusement, especially to the much-worked mind, to speculate on what in future ages may obtain among men in regard to their health, physical and mental strength and beauty, and their length of days. The vision of fair women and strong men living without disfiguring decay until twice three-score years have revolved with them in their journey through life, is like a pleasant dream; and like all pleasant dreams, gives evidence of a healthy parentage—unlike the morbid imaginings of an oppressed mind, labouring under a load of crude and indigestible ideas. This vision has the merit of so impinging upon our minds, as to make us reflect and earnestly consider, whether the scene presented to our mental vision, clothed as it is with apparent reality, if not a reality now, can ever become a possibility. There is nothing unnatural either in the figures or their proportions in this fair vision of man's future earthly life. It contains no ghostly monsters to affright, no so-called superior beings, with plumed anatomical impossibilities, to be wondered at with humiliation: no phosphorescent halos distinguish the good, no sulphur fumes betray the presence of the bad. The men, the women, and their attendant brutes, are unendowed with anatomical impossibilities. If we have learned the anatomy of the vertebrate of to-day, we shall be able to demonstrate that of the denizen of the dream, whenever that dream is realized. We presume the dreamer does not wish us to imagine that the men will be more perfect in their strong beauty than the Greek athletes, who stood as models before Pheidias, or the women more lovely than those whose lines of voluptuous beauty ravished the sculptor of the Venus de Medici. So far, then, we have nothing but what nature has already supplied, and we may reasonably expect to see the like again. Man, too, has been known to live beyond the six score and five years of the people of the dream. Man has lived, and in many instances still lives on the produce of the vegetable kingdom, without shedding the blood of his fellow-creatures. Moreover, there is nothing in his present surroundings in some few favoured parts of the world that will preclude his being as beautiful, as strong, as perfect in health and as long-lived, as he is known from the records of credible history to have been. He may still live only on the fruits of the earth. He may still live in communities governed by natural laws—his average mortality may be reduced to what is now a theoretical minimum—and under these conditions he must *multiply*. A hundred men and women starting in pairs at the time when their bodies have just completed their developmental life—which at the latest may be attained at twenty-five years—would, before each pair had arrived at the age when the reproductive powers wane, have increased to at least six-fold; and as death would neither weed out the little ones, nor excess the elders, we may expect a prodigious increase in this healthy and long-lived community.

Now it must be patent to all that, after a few generations, the vast increasing concourse must migrate either westward or eastward, northward or southward; far away from the first fertile and climatically perfect spot which first attracted their ancestors—perchance from the rich red sandstone soil, with its fertile corn-bearing and fruit-producing vales and sloping hills, well watered, well wooded, well drained, to an adjoining coal-bearing land, where the bleak and barren mountains of millstone grit rear their craggy outline above inhospitable mosses and infertile uplands—where the mineral riches beneath the barren soil await the labour of a race, whose antecedents have not taught them to endure. Forced from the paradise of their father's selection by their loyal desire to obey the most imperative of their father's laws, "Thou shalt not over-crowd thy father's house"—they bid farewell to their happy homes and cease to be what once they were. They stand face to face with the stern reality of change; a change so great they cannot realize it. At first their little ones begin to droop—the parents' hearts sicken at their new grief, and the strong stalwart man, depressed and careworn, seeks with willing hands but with misgiving heart to conquer rugged nature, and force from her the necessary food for those who follow him. The scene is changed—the dream is over—the pleasant vision, like a baseless fabric, has been swept away. Help is called for; and Science, like a good genius, extends her hand. The dreamer and the dream are gone. Large as our world may be, it never has been, and we have no grounds for believing it ever will be, a universal paradise: and without it becomes so, the people of the dream can never become realities.

The records of the rocks teach us each day how, through countless ages, our earth's crust has changed—how what once was the bottom of the sea has formed the loftiest mountains, and how again these snow-capped and ice-scored rocks have had the stable ocean rushing in strong currents hundreds of fathoms above them—and how again, like our own hills, these mountain heights have again emerged capped with tender shells and weeds, the denizens of the deep. Whilst the records of the rocks teach us this, wherever they have been searched, we find not a single writing in the stones that records evidence of either uniform climate, uniform soil, or uniform conditions of any kind whatever, conducing to the perfection of existence either among the lower or the higher classes of animals.

The very factor so necessary to the perfection of type, viz., health, is the great factor of productiveness; and this productiveness is the factor of destruction by over-crowding. Over and over again has this been recorded on the rocks. Without reason, the lower creatures are unable to modify the conditions of life; with reason, man makes the attempt and often succeeds, his first efforts being almost invariably directed towards modifying by his labour the site which he has selected for his home, either from choice or force of circumstances. He tills, he seeks for water, he selects sites for his cattle—in fact, he sets to work to obtain a knowledge of the ground on which he stands; for by degrees

he has learnt how conducive to his health and happiness a practical knowledge is of the earthy crust, from which his food springs, his water is drawn, and on which his habitation rests.

Passing from the dream to the realities, which nature has engraved upon the countless strata-folios of her records, stereotyped in her huge rock volume, whose massive pages envelope the molten centre of our globe, and what do we find?

Records of change on change—records of vast floral and faunal dynasties, each of which has endured for innumerable ages longer than the oldest dynasties of Egypt or of China, and yet we have evidence that nature has allowed, in her infinite wisdom, each to be overthrown—each to become extinct—and give place to a more perfect form. Has this hitherto ceaseless revolution done its work—outspent its force? Will the first dawn of intellect, whose temple is the brain of man, blaze into perfect brilliance during the very first human dynasty on which the great centre of our solar system has ever shone? Will the sweet healthy beauty of nature's queens, the manly symmetry of her kings, so exquisite and perfect to our finite sight, ever remain, for countless ages to come, the crowning product of nature's handiwork?

Does the history of their predecessors warrant us in holding such a belief? True it is that man, unlike his humbler predecessors, has, through his inherent and novel gift of intellect, so cultured his surroundings, so educated his mind, as apparently to have improved his body form and with it the material source of that mind, which differentiates him from his companion brutes.

Apparently, I say; for is it certain that during the twice two thousand years of which we have the records of his dynasty, that he has so improved in mind and body? Are our women and men more beautiful in body, more gifted with mental power, than the Aryans of old, from whose loins sprang the models of Pheidias?—the poet who sang in Sanskrit and in Greek, or their contemporary orators, historians, mathematicians, architects, sculptors and painters? In my own humble opinion, a negative reply must be given to this momentous question. Another question yet, and I will then bid farewell to the dream of my honoured friend, who has so charmed us with his narrative. Whilst men have still preserved their manly and intellectual strength; whilst women still are to be found that would delight the eye of the most exacting sculptor of the ancient Greek school, do we not see around us more degraded human forms than the world has ever known, not only absolutely but relatively? And do we not find these declensions from the normal standard more abundant among the civilized than the naturally barbarous and uncivilized?

And if so, why is it? Is it not because we have fallen short in our pursuit of the necessary knowledge of how to live. We have gone on living and breeding in limited areas; we have confined ourselves to favoured spots, and have spoiled them.

Man has not only spoiled many of the sites which his ancestors wisely selected as vantage grounds against the foe, the flood, and the drought; but is hourly spoiling his own form by his artificial

habits, and laying at the same time the foundation for a still further departure from a natural standard in his offspring. He is polluting the soil on which his habitations stand, he is befouling his water-courses and springs, and he is poisoning the air he breathes. He has thus created surroundings from which he can with difficulty escape; and not content with the natural disease-poisons with which the fens, the tropical lagoons and deltas of the great rivers abound he creates around his own and neighbour's dwelling the conditions that will produce newer and specific forms of disease which disfigure, disable, and kill those nearest and dearest to him.

Man has indeed made his own haunts the haunts of fevers and very magazines of organic poisons; so that the soil, which might have been a perennial source of wealth and health, has become one of disease and death.

It is humiliating to find that branches of science which have been studied for more than two thousand five hundred years should have advanced so little towards the amelioration of the evils with which man is naturally and artificially surrounded. I have said that man has spoiled many of the fair sites on which he has pitched his tent. Also that he has spoiled himself. I have hinted that there are some places which, without man's interference have been the sources of disease.

Hippocrates, who lived between two and three thousand years ago, was a physician, and the founder of medicine. He was in advance of the age in which he lived, and in many things in advance of that in which we live. This extraordinary man lived at a time when there were as his cotemporaries some of the most brilliant men the Greek Islands ever produced. He taught at that remote period how necessary it was to study the nature of the soil in relation to disease, the qualities of the waters which either sprang from it or had flowed over it. He laid down certain rules, which are applicable now to the same locality wherein he practised, as to the selection of sites, &c.; and he wrote a philosophical treatise on airs, places, and waters, which may be read now with advantage, and especially by those who think there is nothing like the learning of the nineteenth century; for they will there see clearly and distinctly shown that diseases have a geographical distribution, and that the soil on which man lives must be studied by the physician who would wish to combat successfully with disease.

The graphic description of the effect of the swampy country around the River Phasis on the dwellers there shows how keenly he observed and how highly he appreciated the facts which nature pointed out to him on the bosom of mother earth.

Hippocrates well knew that whilst the crust of the earth remained as it was in his day, whilst there were deltas, swamps, and lagoons exposed to the heat of the sun, that disease would arise; and that unless these spots were pointed out by the physicians, men would heedlessly settle there, and in the sequel pay the heavy penalty of ignorance which we are doing every day. All this knowledge had been gathered, digested, and sent forth in the most choice language that man could write centuries before the Christian

era; and yet we are, in our boasted nineteenth century, piling up statistics, binding them in blue covers, placing them on our shelves, and converting these volumes that contain them into simple dust collectors. I say that this is humiliating, and certainly does not encourage us in believing that the efforts which Sanitary Institutions are making now will be followed by the anticipated success; at least in this country.

When we sum up our knowledge—I mean that modicum which we have gathered during the last century—and compare it with the gigantic mass collected, digested, and published for the public good by one man long before the Christian era, we shall be startled at its pigmy proportions. This is a time for a great tirade against some of the stupid things that man has invented. We hear of soil pipes, ventilating shafts, and every possible contrivance to keep the sewer gases out of our houses; in doing all this we are only correcting a gross blunder which the boasted intelligence of the nineteenth century committed. We poison our water, and then contrive something to prevent its being done in the future, and think how clever we are; and when we have done one or two things of this kind, we show our friends our houses, give them the name of the engineer or the architect who has rectified, as he thinks, the blunder of a former engineer or architect; we placidly fold our hands, look up contentedly to the sky, think what a wonderful thing we have done—and congratulate ourselves on a chance of living all the days of our life. I maintain that blunderingly altering the blunders of others is not Sanitary Science.

Now I hold that any Institute established for the purpose of teaching us the science of living in a cleanly and wholesome manner—as regards water, air, and soil—should first of all teach in its schools what has already been taught by such men as I have mentioned, as a wholesome restraint against the pride which a little knowledge engenders. Before we can boast of any Sanitary Science, let us be able to point to our researches on the climates, the soils, the diseases, we find at home and abroad in our vast colonies. Let the crust of the earth in various parts of the globe be thoroughly examined in its relation to diseases—recollecting that, had not man been born, there are certain spots in this earth that, produce certain specific poisons, the chemical constitution of which we know nothing. Such spots should be mapped, after having been thoroughly investigated as to soil and climate, for the use of emigrants, colonists, and those in command of our expensive but necessary soldiery—I say necessary, for whilst we have barbarous and uncivilized nations to contend with, like the Russian and Zulu, soldiers will be a necessity; and directly the word soldier is named, what a history of murderous blunders arise to appal us!

For want of studying the geology and climate of the stations to which we have consigned and still continue to consign these expensive but most necessary members of society, how many valuable lives have been sacrificed, how much treasure squandered!

How many times have we sent and shall continue to send our

troops to encamp upon the dried-up beds of rivers which, as Sir Ranald Martin has said, are the deadliest of sites.

How often are we to be taken aback by fever breaking out on such a rock as Gibraltar? When will the conductivity of our soils as regards heat be studied? I have said that man spoils the site which he has selected to live on. Let us only look at that map of distribution of Fever in England and Wales, and know that wherever you see the districts coloured blue in different shades, there are to be found the polluted soils which man has converted into so many beds of disease. You have only to study the geology in connection with these blue groups, and you will soon see the cause.

In conclusion, the author described the several maps exhibited by him, beginning with that on the distribution of Fever throughout England and Wales, and showing the intimate relations that existed between its prevalence and the geological characteristics of the subsoil. He also rapidly reviewed the characteristic features of his published maps of the distribution of Heart Disease and Rheumatism, Consumption and Cancer in Females. Coloured manuscript maps of the distribution of Diphtheria,* Scarlet Fever, Scrofula, etc., were exhibited and described; and lastly he dwelt upon the necessity of popularizing such facts as he had brought before the Members of the Institute, and on this account he hoped shortly to present them in such a form that the work which contained them should be a Health Guide for Great Britain, accessible to all as a book of ready reference for the active medical practitioner and the health-desiring public.

ALFRED HAVILAND, M.R.C.S.

On the Quantitative Elements in Hydrogeology.

§ DEEP SPRINGS.—A. THE AREA OF OUTCROP.

SURFACE GATHERING GROUNDS.

THE depth of rain falling upon the surface of the earth forms the basis of all calculations respecting water-supply.

Thus, the engineer who has to collect water from a mountain gathering ground works upon an actual or assumed knowledge of the mean annual rainfall, but more particularly of the lowest re-

* Whilst showing the distribution of Diphtheria he described the beautiful Geological Model of the south-east of England, by Messrs. Topley and Jordan, of the Royal School of Mines, remarking that the work which had been so well begun should be carried out by Government for the whole of the United Kingdom, and not left, as this admirable work has been, to private enterprise.

corded mean of any short period of years. A subtraction (to a certain extent the result of negative experience) is made for *evaporation*, and a further "allowance" provided for *absorption* by vegetation and porous strata. The area of the catchment basin in square miles being the only thing known with any approach to accuracy, all the other positive results required have, in the first instance, to be calculated from negative elements, and subsequently proved, in the course of years, by actual experience. About ten years ago Mr. Hawksley stated that the largest proportion of the rainfall which it had then been found possible to provide storage reservoirs for, was equal to the average rainfall of the three consecutive driest years. It would be interesting to learn whether the decade that has since elapsed has produced any more positive result than this.

Now in the above case of surface catchment basins there are few parts of these islands of which the rainfall is not now known through the twenty years' work of our President, and, thanks to his admirable organisation, the ratepayer has now some assurance that his money will not be thrown away in works that would fail to supply water (as was the case in 1868 with many gathering grounds) just when it was most wanted. It is, nevertheless, neither equitable nor creditable to the country that a few individuals should be put to a permanent expense in providing data for the good of the community at large.

SUBTERRANEAN WATER SYSTEMS.

Valuable as these rainfall records are for surface gathering grounds, they are in themselves *of no use whatever* for calculating quantities that may be drawn from subterranean water-systems. It is not upon the actual quantity of rain falling that the value of these natural reservoirs depends, but upon the quantity which passes through the soil—*i.e.*, upon the natural percolation.

PERCOLATION.

In percolation we have a net balance, after the settlement of all accounts between rainfall, the soil, and evaporation. The hydro-geologist dates his work from percolators, and bases all his calculations ultimately upon percolation. Unfortunately, however, the investigation of this most vital subject is in a very backward state, and more observations are urgently needed. But for the pains-taking labours of the late Dr. Dalton, Mr. Charnock, and Mr. Dickinson, and of Mr. John Evans, F.R.S., Mr. Charles Greaves, M. Inst. C.E., Prof. Ebermayer, Mr. Baldwin Latham, M. Inst. C.E., and Messrs. Lawes and Gilbert, we should be absolutely destitute of facts upon a subject that affects the pockets of every ratepayer and every individual that seeks to obtain water by means of wells. But all these observations put together amount to a mere bagatelle by the side of those upon rainfall, made by Mr. Symons's organisation alone, to say nothing of Government observations. Yet, notwithstanding this, it is the fact that we are,

as a whole, far more largely dependent upon wells for our supplies than we are upon our mountain gathering grounds.

This chapter of the subject has been fully worked out in my paper "On the Quantitative Elements in Hydrogeology. § *Percolation*," read at the meeting of the British Association at Sheffield, 1879. Percolation is, however, a *known quantity*, and a *positive* quantity which can be experimentally ascertained for every kind of soil.

HYDROGEOLOGICAL GATHERING GROUND.

Given the quantity percolating, or the *mean annual percolation*, the hydrogeologist has no further calculations to make in respect of evaporation or any other negatives, but all his work after that is done with a foot-rule, so to speak. He is concerned only with dimensions. The first of these is the area of the hydrogeological gathering ground. I must here point out the distinction between surface *catchment basins*, which are rightly so called, since they are defined and bounded by a watershed line or ridge that can be seen, and hydrogeological *gathering grounds* which are not *basins* or *catchments*, and which do not coincide either with the boundaries of permeable formations or with those of the surface system of dry basins into which these are divided.

LINES OF DIVISION. SUBTERRANEAN WATER-RIDGES. DISCHARGE BY EFFLUENT SPRINGS.

The hydrogeological gathering ground may be taken as co-extensive with those basins in which the subterranean water systems are found to arrange themselves. These are divided by ridges of water, which can be felt, but not seen. Thus the area of the surface basin, or dry valley system, on the chalk, in the case of the Wandle is $52\frac{1}{2}$ square miles; but, by means of well measurements, an area of $1\frac{3}{4}$ square miles, lying, as regards the dry valley systems, within the Ravensbourne Basin, can be proved to drain into that of the Wandle, making the real gathering ground in the chalk area of the Wandle $54\frac{1}{4}$ square miles. Now, the area of contribution being known, and the percolation on this area being known, it becomes important to ascertain what is the discharge from the area by surface springs. The chalk area of the Wandle basin is drained by the springs between Croydon and Carshalton, and these springs are the source of the river Wandle. Not only the river itself, but all the principal springs have been gauged on various occasions, especially by the late Mr. Braithwaite in the spring of 1853. The springs in the Croydon and Carshalton branches, taken together, then discharged 39,156,680 gallons per day, but the mean discharge of the springs may, for the purposes of this illustration, be taken at 17,000,000 gallons per day. I believe Mr. Baldwin Latham has an elaborate series of gaugings of the river taken daily, but none are yet published.

With some reserve I quote Mr. Evans's mean annual percolation (1835-1860), 8·225 inches, as representing a fair average quantity,

Taking 8 inches as the percolation of the $54\frac{1}{4}$ square miles, that represents an annual supply of . . 7,731,465,600 gallons,
and the discharge of the springs 6,205,000,000 ,,

in the same time, which leaves . 1,526,465,600 gallons.

passing under the tertiary strata between Croydon and Sutton annually.

CASE A.

This is a good illustration of the simplest case which presents itself in hydrogeology of the connection between percolation, the subterranean drainage area, and the yield of that area as measured by springs, leaving the difference=the quantity, passing under the overlying impervious bed. Here, the value of the area being wholly due to the rainfall upon the area, is simply P=VSE+y, where P=Percolation; VSE the volume of the effluent springs; and y the quantity that passes under the tertiaries, and VSE=P—y. As P is measured in inches, VP will represent the volume percolating in gallons. But upon the volume percolating depends the height of the water-line H, and the difference between the highest and lowest positions of H=the *sectional area of variation.* The amount of this variation is enormously greater in the inner parts of the same subterrannean basin than towards its edges, but the *mean variation* evidently bears the same direct relation to the mean percolation as the mean height of the water-line. Given the mean variation of the basin, excess over this mean indicates contribution from the parts of the basin where the mean variation falls short of the mean of the whole area, with due local qualifications. It is, therefore, most important to take daily observations of the height of the water-line in wells. Now, the whole area of outcrop of each porous stratum is made up of such little basins, each independent of the others as long as they are not artificially disturbed. Clearly, therefore, *the first object of the hydrogeologist is to map out the subterranean drainage areas.* These show where the percolation on every part of a permeable formation goes to. All the subdivisions of the chalk area from the Medway to the Itchen (Hants) have been described in my paper on "Watershed Lines."*

The knowledge of the positions of these basins is gained by determining the form of the upper surface of the water in the porous stratum. This is done by well-measurements; and, in fact, that is the principal object of well-measurements. These measurements would be useless if they were not referred to Ordnance datum. Every well-mouth has to be levelled, a work of little difficulty where the 6-INCH maps are published, but practically impossible for one individual where there is only the old 1-INCH MAP. The 6-INCH map is therefore an indispensable foundation for a perfect hydrogeological survey.

* Conf. on National Water Supply, &c., Soc. of Arts, 1879, p. 91.

WATER CONTOURS.

When the water levels have been thus determined by synchronous observations over a sufficient area, contours may be drawn by casting a series of sections, taken in all directions through the wells of observation, and passing a curve through all the points of equal altitude on these at specified intervals of elevation, such as every 10, 50, or 100 feet, according to the fulness of the data. A good map should show contours at every ten feet, and should show separate contours for the highest position to which the water rises and the lowest to which it falls, after much and little percolation.

Altitude is an element of quantity. For it will readily be seen that each successive contour describes a smaller figure than the one immediately below it and a larger figure than the one next above it. Here we see that equally with the 6-INCH ORDNANCE maps, the geological survey map is required as a basis to work upon—not the old 1-INCH map, but the 6-INCH geological map—for the water contours found by well-measurements do not by themselves inclose a space but terminate abruptly, on meeting those of equal altitude upon the upper surface of the impervious stratum below. A curve passed through these points of intersection marks the upper limit of the water system, or the line of abutment of the plane of the upper surface of the water system against that of the upper surface of the impervious stratum below. This shows the relation of hydrogeological work to geological. A hydrogeological map is a geological map and something more. While the geological survey map exhibits merely the superficial areas occupied by certain kinds of rock, the hydrogeological map shows not only the areas occupied by water, but the form of that water by contour lines, and wherever possible the contours of the top and bottom of each permeable stratum. The difference in altitude between the water contours and those of the bottom of the containing stratum gives the volume of the stratum occupied by water, while the contour lines themselves, with the "line of abutment," which marks the boundary of the water system, measure the *area* of water in the stratum above the level of each contour given. Thus, *the higher the level the smaller the quantity.* If the percolation be known, the possible yield of the area *above* each contour may easily be found.

Suppose it is in contemplation to sink a well on the chalk hills, the height of the surface should be first determined; then, from the hydrogeological map, the maximum and minimum height of the water at that point should be ascertained. The difference between the height of the surface and the minimum water line gives the minimum depth of the well. And now arises a difficult question. Suppose the well to be sunk upon a dome, where the minimum water line is at 330 feet above O.D. mean tide at Liverpool, and that the 300 contour runs round it, inclosing

an area of one square mile, then if the bottom of the well be carried down to 300 feet above O.D., and the water pumped down to that level, what area will drain in towards the well? Clearly *less* than the area inclosed by the 300 contour. Therefore the yield cannot be so much as the percolation on one square mile. Again: To how much below 300 feet would it be necessary to pump the water down in order to make the space inclosed by the 300 feet contour drain in to the pumps—*i.e.*, that the yield of the well may equal the percolation on one square mile? Now the percolation on one square mile at eight inches per annum is 115,827,200 gallons, 317,334 gallons per day, and 13,214 gallons per hour. That is a very large yield, but by no means an impossible yield, for a well at the summit of the system, and under no superior pressure, as the effect of such pumping has been felt for upwards of a mile. But how much it might be necessary to reduce the column of water in the well below 300 feet to produce this I cannot say. This case is an extreme one in every way, but the simplest form in which the quantity question presents itself, and it is evident that daily gaugings of all wells, with records of the hours of pumping and the quantity pumped, would soon remove the doubt. The same reasoning is equally true of smaller areas; for instance, the 310 or 320 contour might inclose a space equal to half a square mile or a quarter of a square mile, which would give respectively, at 8 inches' percolation, 57,913,600 and 28,956,800 gallons in the year; 158,667 and 79,333 gallons per day; and 6,611 and 3,305 gallons per hour.

Now from the simple case of the contours of a dome, we may take any point on the water system in the area of outcrop such as the chalk hills. By projecting lines from this point, taking the superior contours of the system at right angles, we see what area naturally feeds towards this point. These boundary lines may take a sinuous course up to the line of abutment, or limit of the system, or they may simply run up to the line of a water-ridge. The area inclosed may be measured in square miles, and the percolation known. Then arises the question, What extra area will be caused to contribute—that is, what extra quantity will be drawn in by pumping the water down 10, 20, 30, or 100 feet? These are questions that may easily be answered if wells are regularly gauged and recorded. It must be borne in mind that elevations in the water system, whether domes or boundary water-ridges, indicate *absence of fissures* in the rock, and depressions free channels; and that water flows *from* the elevations, and *towards* the hollows. On this principle a reduction of 10 feet in the water line should have a greater quantitative value in the hollows than on the ridges. This is a necessary result from the measurement of areas of contribution above described.

There is no part of the area of outcrop of a water system in which the apparently insuperable difficulties in the way of calculation of quantity afforded by the elements of uncertainty above mentioned may not be overcome by systematic observations of the

daily fluctuations of level herein recommended. A great stumbling-block in the way of such observations is the want of a suitable instrument wherewith to gauge them. Having for many years had my attention practically drawn to this point, I have constructed a very simple self-registering gauge capable of registering fluctuations to *any amount*. The apparatus will be described in a separate paper.

CONVERGING POINTS.

Now we can take the case of the converging points of a water-system—*i.e.*, the effluent springs. The volume of a spring predicates the area of contribution, assuming the percolation known *absolutely* as regards the springs flowing out by the base of a water-bearing bed, and *approximately* (but falling short of the real amount) as regards those issuing from its top. The mean volume of the springs and the mean height of the water-line are co-ordinate quantities $VH = VP = VSE + y$. Therefore the daily register of the volume of springs is an element in the quantitative value of each height of the water-line. The mean volume of a spring flowing from the base of a water-bearing bed exceeds the mean quantity that could be drawn from a well in the same basin, unless the well dried the spring up, when the yield of the well would simply be that of the spring. In the case of springs issuing from the top of a bed a well might procure a mean quantity larger than the mean flow of the springs by drying the spring, and pumping part of what naturally descends under the overlying impervious stratum. The springs of Croydon, Beddington, Wallington, and Carshalton are of this class. They are in too great volume for any one well, but it would be possible to pump, from a line of wells in the three miles, a quantity exceeding the mean volume of the springs themselves, or about 20,000,000 gallons a day. This is given merely as an illustration, and in an area where it never could be expedient to tamper with the springs. As to the *appropriation* of the springs themselves, that is a wholly different question, and as this question will at no distant future form a subject for the consideration of Londoners, I desire to express my wonderment that vested interests have been so long able to withhold some of the finest and best spring water that the world produces—and all ready to its hand—from the great city.

POSTSCRIPTUM.

The consideration of the quantitative values of the vertical fluctuations of the water-line, and of the formulæ of compound areas, such as that of a river basin in which the various streams traverse and partly mingle with various subterranean water-systems, will form the subjects of special chapters.

JOSEPH LUCAS, F.G.S.

The discussion was commenced by

DR. A. CARPENTER, who said there was much in Mr. Lucas's paper of considerable importance, and it was worthy of great

attention by various classes of persons ; but he must object *in limine* to one of Mr. Lucas's observations, viz., the surprise expressed by the author, that the Metropolitan authorities did not possess themselves of the springs which now supplied this district. He protested most strongly against any such appropriation. It was said by Bismarck, that as regards the Russians in Turkish territory, "*Beati possidentes;*" he would say the same as to the position of Croydon at the head of the springs of the Wandle, and he hoped that a most strenuous opposition would be offered to any Corporation or Company who at any time attempted to appropriate that which was one of the greatest treasures that the people of Croydon possessed. He was glad to hear Mr. Lucas estimate the yield of water so high. The Local Board at this time were abstracting about 2,250,000 gallons daily. Mr. Lucas says, the supply is equal to 20,000,000 gallons, so that we need be under no apprehension of failure of supply in ordinary seasons, but he thought the author had probably over estimated the quantity available. He (Dr. Carpenter), looked with dismay at the attempts which were being made on all sides to diminish the amount at the command of the Croydon Local Board. There was the Caterham Water Company; the Kenley Water Company ; the Caterham Asylum, and more recently the Surrey Magistrates at the New Asylum which is to be erected in Hooley Lane, and now Mr. Lucas advises the Metropolitan authorities that they ought to come to our discomfiture. It was to be earnestly deprecated, and the Croydon people would have a right to be heard whenever the attempt was made. There was one good point in the case, it proved to the Croydon people that their water supply was worth having.

Mr. W. Barns Kinsey said, I had found great assistance in coming to a conclusion as to the water supply of a locality by drawing contours and sections as suggested by Mr. Lucas, and that in the Thames Haven well I had worked upon this system knowing that an infiltration of salt-water could not take place so long as the boring was carefully lined, and the fresh water was under a pressure that exceeded that of the sea at its mean level. I understood Mr. Lucas to say he was glad to hear of good water being obtained by going deeper for it, as his experience at Sandgate was that by going deeper he obtained salt-water. I replied that such was not my experience, as I knew very good water had been obtained in a like formation elsewhere.

A vote of thanks was then moved by the Chairman and carried. This was acknowledged by Mr. Lucas.

"Particulars of an Artesian Well at Thames Haven, Essex."

Executed for the Thames Haven Company (Limited).

The boring was commenced February 6th, 1877, by Messrs. S. F. Baker and Sons, the contractors, at a distance of about 450 yards from the river bank, and at the surface of the marsh, with a diameter of 16 in.; passing through light brown clay for a depth of 16 ft., peat 2 ft. 6 in., soft ooze 4 ft. 2 in., grey sand 25 ft. 10 in., grey clay stones and shells with thin veins of black greasy sand 2 ft. 3 in., sand and stone some $3\frac{1}{2}$ in. diameter, forming a dark gravel, 27 ft. 6 in.; making a total depth of 78 ft. 3 in. to the top of the clay.

The boring was lined as the work proceeded with cast-iron pipes, 16 inches internal diameter, having turned and bored flush socket joints; and a sample of the water was taken before the pipes touched the clay, which on analysis showed—

Total solid matter . .	3367·0	grains per gallon.
Volatile organic . .	333·0	,,
Chloride of sodium . .	1190·0	,,
Nitrogen as ammonia .	4·48	,,
Nitrogen as albuminoid ammonia	3·10	,,

The water level in the bore when at rest was at this time 5 ft. 6 in. below the level of marsh.

From 71 ft. 3 in. to 107 ft. the boring was in a stiff dark brown clay into which the 16-in. pipes were driven to a depth of 12 ft. 3 in. or 90 ft. 6 in. from the surface, the water being then pumped out and the joints of pipes examined.

From the bottom of these pipes the boring was reduced in size and lined with 3-in. diameter cast-iron turned and bored flush jointed pipes, passing from 107 ft. to 112 ft. 10 in. through sand and clay in veins; from 112 ft. 10 in. to 114 ft. through sandy clay and shells; 114 ft. to 115 ft. 6 in. sandy clay; 115 ft. 6 in. to 118 ft. 6 in. sandy clay and pebbles; 118 ft. 6 in. to 122 feet 6 inches running light coloured sand with water.

Analysis of the water gave—

Total solid matter . .	481·33	grains per gallon.
Volatile organic . .	66·60	,,
Chloride of sodium . .	347·61	,,
Nitrogen as ammonia .	3·50	,,
Nitrogen as albuminoid ammonia	·21	,,

The water level in the bore when at rest was 6 ft. 4 in. from surface of marsh. The formation was—

From 122′ 6″ to 123′ 9″ sand and oyster shells;
,, 123′ 9″ to 133′ 0″ dark sand with shell fragment;
,, 133′ 0″ to 136′ 0″ yellow ochreous sandy clay;
,, 136′ 0″ to 145′ 0″ greenish sandy clay;

From 145′ 0″ to 155′ 0″ fine green light coloured sands, firm and dry;
,, 155′ 0″ to 157′ 0″ dark sand and pebbles with fragments of shells.

forming basement bed of Woolwich and Reading beds.

From 157 feet to 233 feet fine greenish sand, being a running sand full of water to 166 feet; more solid and close at 170 feet; very hard and dry at 180 feet; and from 193 feet to 233 feet a running sand with water. The water at 200 feet was salt to the taste and its level in the bore when at rest 4 feet from surface.

From 233 feet to 268 feet the boring was continued through a greenish clayey sand which at 246 feet was of a plastic nature; at 253 feet, close, dry, and firm; at 256 feet, dry but looser; 259 feet to 262 feet, bands of hard dry sandy clay; and from 262 feet to 268 feet, more or less rotten sand and clay.

At 268 feet a bed of green-coated flints was touched, forming basement bed of Thanet sands, and resting on the chalk at 268 ft. 6 in. from surface of marsh.

The boring was continued into the chalk and the 9-in. pipes driven therein 5 ft. 6 in. or a depth of 274 feet from surface, and a joint made between the 16-in. and 9-in. pipes with hydraulic cement, the 9-in. pipes being brought up to the level of the marsh.

The water was now noticed to ebb and flow with the tide to 6 inches above and 6 inches below the marsh level; but upon testing with a powerful pump passed down the bore, it was found that the Thanet sands were drawn down into the boring through fissures in the chalk, and a strong wrought-iron tube with steel shoe was therefore inserted to shut back the sand, and driven 40 feet into the chalk, a perfect joint being ensured by bringing it up to within 69 feet of the surface and filling the space between it and the cast-iron pipe with hydraulic cement which was found to run into the fissures of the chalk; the water level in the bore being also higher afterwards. An open boring 6 inches diameter was continued from this point, passing through a marly chalk to a depth of 355 feet to flint water bearing, veins at 360 feet.

A test was now made of the supply which was found to be equal to 520 gallons per hour at 100 feet deep. The level of the water at rest in the bore being 11½ inches above marsh at high water, and the analysis showed a much better result. viz.:—

Total solids . . .	43·00	grains per gallon.
Volatile organic . .	1·95	,,
Chloride sodium . .	17·32	,,
Nitrogen as ammonia . .	·1000	,,
Nitrogen as albumenoid ammonia	·0074	,,
Sulphate of lime . .	3·00	,,
Carbonate of lime . .	5·80	,,

At 367 feet the chalk was greyish and firm without water; at 426 feet, chalk hard and white; at 440 feet, hard chalk; at 460 feet, soft chalk with flints and water veins; at 475 feet, darker and harder chalk; at 502 feet, flint veins full of water; which being

tested gave a yield of 1300 gallons per hour at 100 feet depth for the veins at 460 feet, and of 2200 gallons per hour for those at 502 feet; the water level being also higher in the bore, or 1 ft. 2 in. above surface at high water.

The analysis gave—

Total solids	42·80	grains per gallon.
Volatile organic	·05	,,
Chloride sodium	17·44	,,
Nitrogen as ammonia	·0385	,,
Nitrogen as albumenoid ammonia	·0046	,,
Sulphate of lime	2·50	,,
Carbonate of lime	5·80	,,

At 506 ft. 7 in. the chalk was again grey and waterless; at 521 feet, white chalk with flints and water; at 529 feet, grey chalk, no water: at 536 feet, soft chalk with cavities, the flint veins being further apart but full of water; but from 540 to 545 feet the chalk was hard and dark, and the bottom dry and waterless; at 550 feet the chalk was softer and whiter, which changed into a white marly chalk at 566 feet, and continued to the bottom of boring at 572 feet.

The water level had now increased to 1 ft. 7 in. above level of marsh at high-water spring tides, and at low-water 7 inches below surface.

The analysis gave—

Total solids	44·80	grains per gallon.
Volatile organic	·50	,,
Chloride of sodium	17·78	,,
Nitrogen as ammonia	·0063	,,
Nitrogen as albumenoid ammonia	none.	
Sulphate of lime	none.	
Carbonate of lime	3·50	,,
Hardness before boiling	7·8°	Clark's scale.
Hardness after boiling	4·6°	,,

The final analysis of the water, made by Mr. G. W. Wigner, F.C.S., London, from a sample taken on the 18th June, 1879, two hours after commencing pumping, gave the following results:—

Physical characteristics: Colour in two-foot tube, very good pale blue; suspended matter, none; smell when heated to 100° Fahr., none; taste, very slightly saline; hardness before boiling, 9·3° Clarke's scale; hardness after boiling, 5·7° Clarke's scale.

Chemical results—

	grs. per gal.
Total solid matter	43·76
Total mineral matter	42·88
Loss on ignition	·88
Chlorine as chloride of sodium	16·38
Lead and copper, none. Iron, traces	
Lime	1·84
Magnesia	1·78
Alkaline salts as carbonates	9·00

Sulphuric acid in combinations . .	6·17
Phosphoric acid, traces . . .	
Nitrogen as ammonia	·0700
Nitrogen as albumenoid ammonia, none.	
Nitrates and nitrites, traces only.	
Oxygen absorbed by organic matter from solution of permanganate of potash, none .	
Appearance of dried residue, white semi-crystalline	

The microscopical results were quite satisfactory; no living organisms could be detected.

Dissolved Gases:—

Carbonic Acid . .	none.
Oxygen . .	·25 cubic inches per gallon.
Nitrogen . .	2·00 „ „

The valuation of the water by Wigner's scale, taking the average value of London water as about 25 and the best public supplies at 10 to 15, after making suitable allowance for the source from which the salt is derived, is 21; it is therefore a first-class water.

The mineral constituents are probably combined as follows:—

Sulphate of lime . . .	4·47
„ magnesia . . .	5·34
Carbonate of potash . . .	8·00
„ soda . . .	6·04
Chloride of sodium . . .	16·38

These results indicate that as regards organic matter the water is very pure, only 0·88 grains per gallon is driven off on ignition, and 0·68 of this is the combined water of the sulphate of lime. The actual organic volatile matter is therefore only 0·20 grain per gallon.

The only objectionable feature is the proportion of salt; but as the other figures of the analysis, and especially the figures of combined nitrogen, prove conclusively that the salt is not derived from organic sources, its presence is of far less moment.

The results of this analysis showed a marked improvement on the last and preceding ones.

It is a water well fitted to furnish a supply for drinking purposes, and which from the regularity of its mineral constituents will probably continue in good condition.

Although the water overflowed the surface, it was found possible to exhaust it to a depth of 80 feet by hard pumping. A pump was therefore designed of special construction that could be placed within the bore at a sufficient depth to ensure a constant supply, and at the same time be readily lifted for repairs.

The pump delivers an equal quantity of water at each stroke, and is suspended in the bore from a bed-plate attached to the head of the bore-pipe, the total depth of pump being 198 feet from the surface.

The machinery is arranged to allow for the varying level of the

water, which, from overflowing the surface, is reduced to 100 feet or thereabouts, and has not been exhausted.

The valves and other details of the pump can be lifted to the surface for examination by means of suitable tackle suspended to the stand-pipes, which are attached to the pump bed-plate on each side of the boring, the engine being fitted with hoisting gear.

The pump valves are constructed of a combination of metal and india-rubber chemically united, and work without shock.

The engine and pumping machinery is enclosed in a corrugated iron building, built upon a solid concrete foundation, resting upon the surface of the marsh.

A louvred ventilator is arranged above the boring, upon hinges to enable it to be opened when the pump rods are lifted.

The engine is of the patent "Robey" type of four horse-power nominal, connected to the pump gear by a steel spur-wheel and pinion, and cuts off at one-third of the stroke. Its present duty is 26,000 gallons per day, but the water supply and machinery are equal to a considerable increase if required.

The results show the possibility of obtaining good water even when the surface and deep springs are contaminated, and are very satisfactory in a district notorious for the impurity and deficiency of its potable water.

W. Barns Kinsey, *Consulting Engineer.*

APPENDIX TO THE ABOVE.

The temperature of water at various depths taken by repeated experiments and with three lengths of pump, viz:—20 ft., 72 ft., 100 ft., to which depths the water was pumped down, gave with a depth of boring of 370 ft., 54°, 55° and 56° Fahr. respectively, the testing extending over three days, and the temparature of the air falling from 50° on the first day to 34° on the third.

With a depth of boring of 521 ft. the temperature of water was with a 20 ft. length of pump 56°, 72 ft. 58°, and with 100 ft. 58°.

With a depth of boring of 572 ft., and the highest temparature of air 80° in the shade the highest temperature of water was 58°. There was no difference between the readings at 521 ft. depth of boring and those at 572 ft., and this may be accounted for from the fact that the largest supply of water was obtained at 536 ft.

The temperature of the water in the old well which has a depth of 130 ft., taken at 8 ft. from the surface of the marsh, was 51° with an air temperature of 50°.

The temperature of water from the new well after five minutes pumping was 54°, and after working three hours 58°, the depth of pump being 198 ft. from the surface, the temperature of the air 50°, and the level of the water when commencing to pump 12 in. above surface.

A further test was made after a rest of eighteen hours, with the following results:—

Temperature of air in the shade 46° Fahr.

Temperature of water in the river at high water 48° Fahr.

Temperrture of water in old well, at same time 48° Fahr.

Distance of surface of water below surface of ground in old well 7 ft. 6 in.

Temperature of water taken at testing cock of pump of new well 2 ft. 6 in. above the surface of the ground, after resting eighteen hours and emptying stand pipes and pump to that level 46° Fahr. Temperature of water at testing cock after working pump a sufficient portion of the stroke to empty it of all water above the level of 12 in. above surface of ground, at which point the water would overflow if free 50°.

The other temperatures remained as in previous tests.

Prof. Wanklyn objected to the analyses on the ground that the results proved that old and inaccurate methods must have been used to obtain them.

The Chairman, in moving the vote of thanks made some remarks on the temperature of the earth in boring Artesian Wells, and explained the precautions necessary to be taken in order to secure accuracy.

Rain collected from Roofs considered as a Domestic Water Supply.

Meteorology and Sanitary Science are very closely connected. Meteorology deals with all the properties and changes of the atmosphere which surrounds our earth; and Sanitary Science has to arrive at the best means of keeping that air pure and in a satisfactory state for respiration, and to deal with the deposits from it, not only to prevent them injuring man, but also to obtain the greatest advantage from them in all ways.

One of the chief points of connection letween the two sciences is rainfall; Meteorologists study the moisture in the atmosphere, its various forms and conditions, the causes which deposit it on the earth as rain, and the quantity deposited at various places. Then the Sanitarian has to take up the question of how it shall be dealt with? which naturally divides into two branches—Water Supply and Drainage, making use of the water, and preventing it doing mischief; and his chief object is so to balance the two as to get rid of it without its doing any harm, and yet to get all the good he can out of it.

We are entirely dependent on rain for our supply of water; for whether we catch the water which falls on our roofs, or obtain it from shallow or deep wells, or from streams and rivers, it is nothing more nor less than rain. The subject of Water Supply has many branches, and perhaps the most important is plenty of good water for domestic use, though the supply for manufacturing and general purposes, and for power is of vast importance, and the different interests are generally very conflicting. The agriculturist

to prevent the water standing on his land, drains it into the water-courses, which receiving it quicker than would naturally be the case, overflow and cause mischief by floods; he also manures his fields and some of the manure is washed down the drains, and instead of enriching the soil, pollutes the water. Then the manufacturer not only wants to receive the water clean and to send it away dirty, but, to get power out of it, he backs up the stream with dams and weirs, and causes floods above him; in short, every riparian owner wishes to receive the water pure and to empty into it all superfluous water, sewage, and refuse of all kinds, and to have absolute control over the river; not caring whether those above and below him are flooded, or deprived of water altogether.

When a supply of water is wanted for a large town, the first question is where is there a large rainfall within reasonable distance? Then geology plays an important part, the structure and natural products of the gathering ground affecting not only the quality and quantity of water that can be made available, but also the cost of the necessary works and reservoirs. For the use of towns the water can be brought in bulk, and having only to be distributed over a small area the cost though great can be easily met, but in small villages and rural districts the cost of distribution would be so great that a supply in this manner is altogether out of the question. In these districts, however, the importance of a sufficient quantity of pure water for domestic purposes is very great, and seems to be only equalled by the difficulty of obtaining it. The usual sources of supply are the small streams and shallow wells; the streams are scarcely ever pure enough for drinking, and the wells are very frequently much too near cesspools and house-drains, to say nothing of the miscellaneous organic matter with which surface water must necessarily be polluted. This is not all; one well generally supplies several cottages, and the distance which the water has to be carried, prevents it being used in anything like sufficient quantity for thorough cleanliness; and in hot and dry weather when a plentiful supply is more than ever needed, the well often runs dry, or at least, the scarcity of water causes frequent quarrels.

Perhaps the simplest solution of the difficulty is storing the water which falls on the roofs of houses, if a sufficient quantity can be obtained in this manner, and the object of my paper is to consider this question.

The average rainfall over the British Isles varies from about 20 inches to nearly 200 inches per annum. The largest amounts being recorded in the English Lake district, and in the mountainous districts of Wales and Scotland; and the smallest in the eastern and midland counties of England. I have selected four fairly representative stations with average rainfalls of approximately 22, 25, 35, and 45 inches, on which I have based my calculations. Stations where the fall is much above 45 inches are only found in mountainous districts which are generally rocky, and consequently there is no difficulty in obtaining a supply of water from the streams which are numerous, and in

such districts usually sufficiently pure. The two average falls, 22 inches and 25 inches, may appear rather near each other in amount, my reason for adopting them was that the 22 inches was the lowest satisfactory average I knew of, obtained from a sufficiently large number of years, and 25 inches represents the fall over a larger part of the country than any other amount.

In dealing with my subject, I shall consider more particularly the supply of labourers' cottages; for although pure water is as necessary to the middle and upper classes of the community, they have the matter more in their own hands, and can, as a rule, meet the necessary expense of procuring a good supply.

Taking the average size of a cottage as 15 ft. by 20 ft., which I think is not far from correct, the average yield of water for a year, with a mean rainfall of twenty-five inches, would be 3,900 gallons, or nearly 10·7 gallons per day, but this is without allowing anything for loss in collecting, which is considerable. From measurements of the flow of water from a tiled roof in average condition, I find that about twenty per cent. is lost. First, there is the water absorbed by the tiles; then a considerable quantity is held between the tiles by capillarity; and, lastly, some is lost by splashing off the edges of the roof and out of the gutters. On a slated roof, I believe the loss might be reduced to between five and ten per cent.

Then, also, we must not calculate the supply only from the average rainfall, but from the fall in a dry year. Thus, at a station with a mean annual rainfall of twenty-five inches, the amount in the driest year is about seventeen inches. This would yield 2,653 gallons. Deducting twenty per cent. for loss, 531 gallons leave as available supply 2,122 gallons, or little more than 5·8 gallons per day, which would be altogether inadequate for the use of four or five persons — the presumed number of the inhabitants of the cottage.

With a mean rainfall of thirty inches, we should have an average supply of 10·3 gallons per day, and in the driest year 6·9 gallons.

With a 35 in. rainfall	12·0	gallons, and	7·7	gallons per day
,, 40 ,,	,, 14·5	,,	,, 10·8	,,	,,
,, 45 ,,	,, 16·4	,,	,, 13·1	,,	,,

I have not been able to find anywhere a statement of the requisite quantity of water per head, per day in rural districts. In towns the quantity varies from about twelve gallons to about fifty gallons; but there can be no comparison, as in towns a large proportion goes for trade supply and for general Sanitary purposes; a great deal is wasted by bad fittings; and the amount used for water-closets, which are almost unknown in country cottages, is, I believe, considerably more than half the quantity delivered to each house.

I think there can be little doubt, that a cottage with an average supply, of twelve gallons per day of pure water close to the house, would be considerably better off than nine-tenths of the English cottages in their present condition; but this could only be obtained from a tiled roof in places where the mean rainfall was thirty-five inches and upwards. In places where the rainfall was less, this

method could only be adopted with satisfaction as a supplemental supply, or for potable water where there was another supply for cleansing purposes.

It is of considerable importance that the water collected on roofs be properly stored. A great deal might be said about the objection to storing in wooden butts, or cisterns of any kind above ground which are often exposed to the sun, and are liable to receive various impurities, the water becoming unfit for consumption after a very short time, and I believe it is from this cause that a great deal of the prejudice against rain-water as a beverage has arisen, for if properly stored it is probably the most wholesome of all waters. The best receptacle is an underground tank or well, bricked at the sides and bottom, and lined with about half an inch of Portland cement, to prevent any possibility of loss from leakage or pollution from the infiltration of impure water from the surrounding ground; the top should be domed over leaving a man-hole, so that the tank may be occasionally cleaned; the man-hole should be covered with a slab of paving stone laid in mortar, to prevent worms or insects getting in and polluting the water. The pipes from the roof to the tank where they pass underground should be of glazed earthenware, and the joints made with cement, so as to be both watertight and impregnable to insects and other polluting matter from the outside. They should not go straight into the tank, but into a small receptacle beside it, in which any dead leaves or other matter carried down from the roof would be intercepted, so as not to reach the tank and decay in the water. This receptacle should be made with a closely-fitting movable cover, so that it could be occasionally cleaned, which would aid materially in keeping the water pure. The tank should also have a waste-pipe to allow any surplus water to escape, the end of which should be covered with a piece of perforated zinc or copper wire gauze, to prevent frogs, mice, or other vermin having access to the water. A tank carefully constructed in this manner will not require cleaning more than once in two or three years.

The size of the tank is perhaps the next point for consideration; to insure a regular daily supply proportionate to the yearly fall, the tank must be of sufficient capacity to store all the water that falls during the wet periods of the year, for if during the spring some of the heavy rains run to waste, the water kept in store will not be adequate to meet the daily demand during the dry summer weather, for it is evident that anything deducted from the yearly amount of rain even during the wettest season must of necessity reduce the average daily supply that it is capable of yielding. I have, therefore, calculated the requisite capacity of the tank from the surplus yield of water during the three wettest months, and find that for a cottage 15 ft. by 20 ft.—the size on which I have based all my calculations—with a rainful of 20 inches the tank would require a

capacity of	150 cubic feet, or	5 months' supply
with a rainfall of 25 inches,	200 ,,	5 ,, ,,
,, ,, 35 ,,	235 ,,	4 ,, ,,
, ,, 45 ,,	250 ,,	3 ,, ,,

The decrease in the proportionate size of the tank with larger rainfalls is due to the different relation which the wet periods in dry districts bear to those periods in wet districts; that is to say, that where the average rainfall is 20 inches, the fall during the wettest three months will be about 75 per cent. of the mean annual fall; while at stations where the mean rainfall is 45 inches, the wettest three months will be only about 50 per cent. of the annual fall. Or, to put it very simply, at wet stations the fall is more evenly distributed over the year.

The cost of tanks such as I have described is not great, and would not exceed one shilling for each cubic foot of capacity, that is a tank holding 100 cubic feet would cost £5. and so on. When a storage capacity of more than 200 cubic feet is required, it will be found advantageous to make two or more tanks rather than one large one.

In the foregoing I have worked on an average condition of things and of course the results are averages, and there are various disturbing elements; as before stated, I have taken as my basis a cottage having an area of 300 square feet with a tiled roof in fair condition, the inclination of the roof being about 35°. I do not think the inclination of the roof has much effect, for though a steep roof would catch rather less water, it would run off more freely and less would be held between the tiles by capillarity; of course with a very flat roof the conditions would be reversed. On a slated roof there can be no doubt that the loss would be less, and, as before mentioned, need not exceed 10 per cent.

I think the most important element is the position and bearing of the house, for if a house has a large expanse of steep roof facing a wet wind, it will, undoubtedly, catch more than the average, especially if it is in an exposed situation. I believe, as a general rule, a flat roof will catch most water in a sheltered position, and a steep roof in an exposed position, if it presents a fair proportion of roof to the wet winds.

It is hardly necessary to state that in calculating the yield of water from any roof, the area of the ground covered by the roof should be taken, and not the area of the roof itself.

The question of Water Supply is perhaps engaging more attention now than it has ever done before, and I hope the few facts I have given on what appears to me one of its most difficult branches, and at the same time one that seems most likely to be overlooked—the supply of country cottages—have not been altogether useless or uninteresting.

In conclusion, I should like to express my thanks to the President, Mr. Symons, for allowing me the free use of his rainfall records which were so essential for the compilation of this paper.

APPENDIX.

Table showing the daily yield of water from roofs of various sizes with varying rainfalls.

Area of House 10 ft. × 20 ft. or 200 sq. ft.

Mean rainfall.	Loss from evaporation, &c., per cent.	Requisite capacity of tank.	Mean daily yield of water	Mean daily yield of water in wettest year.	Mean daily yield of water in driest year.
in.		cubic feet.	gallons.	gallons.	gallons.
20	25	100	4·3	6·7	3·2
25	20	135	5·7	7·5	3·9
30	20	145	6·8	9·4	4·5
35	20	155	7·9	11·0	5·0
40	15	165	9·7	13·1	7·2
45	15	170	10·9	14·2	8·8

Area of House 15 ft. × 20 ft. or 300 sq. ft.

Mean rainfall.	Loss from evaporation, &c. per cent.	Requisite capacity of tank.	Mean daily yield of water.	Mean daily yield of water in wettest year.	Mean daily yield of water in driest year.
in.		cubic feet.	gallons.	gallons	gallons.
20	25	150	6·4	9·9	4·8
25	20	200	8·6	11·3	5·8
30	20	225	10·3	14·2	6·9
35	20	235	12·0	16·7	7·7
40	15	245	14·5	19·6	10·8
45	15	250	16·4	21·4	13·1

Area of House 20 ft. × 25 ft. or 500 sq. ft.

Mean rainfall.	Loss from evaporation, &c., per cent.	Requisite capacity of tank.	Mean daily yield of water.	Mean daily yield of water in wettest year.	Mean daily yield of water in driest year.
in.		cubic feet.	gallons.	gallons.	gallons.
20	25	250	10·7	16·6	8·0
25	20	335	14·3	18·7	9·7
30	20	375	17·1	23·6	11·4
35	20	390	19·9	27·7	12·7
40	15	405	24·2	32·8	18·0
45	15	415	27·3	35·7	21·8

Area of House 20 ft. × 50 ft. or 1000 sq. ft.

Mean rainfall.	Loss from evaporation, &c. per cent.	Requisite capacity of tank.	Mean daily yield of water.	Mean daily yield of water in wettest year.	Mean daily yield of water in driest year.
in.		cubic feet.	gallons.	gallons.	gallons.
20	20	500	22·8	30·1	15·5
25	15	665	30·3	40·0	20·6
30	15	740	36·4	50·3	24·4
35	15	785	42·4	59·0	27·0
40	15	815	48·4	65·3	36·3
45	15	835	54·4	71·3	43·5

Area of House 25 ft. × 80 ft. or 2000 sq. ft.

Mean rainfall.	Loss from evaporation, &c. per cent.	Requisite capacity of tank.	Mean daily yield of water.	Mean daily yield of water in wettest year.	Mean daily yield of water in driest year.
in.		cubic feet.	gallons.	gallons.	gallons.
20	20	1010	45·6	60·2	31·0
25	15	1330	60·6	80·0	41·2
30	15	1480	72·7	100·5	48·7
35	15	1570	84·8	118·0	54·0
40	15	1630	96·7	130·6	72·6
45	15	1670	108·8	142·7	87·1

Particulars of Tank or Well

Capacity.		Dimensions.			Approximate cost.
Cubic feet.	Gallon .	Square, length of side.	Circular, diameter.	depth.	
		ft. in.	ft. in.	ft in.	£ s.
100	624	4 0	4 6	6 6	5 0
125	780	4 0	4 6	8 0	6 5
150	936	4 6	5 0	7 6	7 10
175	1092	5 0	5 9	7 0	8 15
200	1248	5 0	5 9	8 0	10 0
225	1404	4 0 4 0	4 6 4 6	7 0 7 0	11 5
250	1560	4 0 4 0	4 6 4 6	8 0 8 0	12 10

H. Sowerby Wallis, F.M.S.

Since writing my paper I have seen an article in the *Sanitary Record*, of Oct. 20th, by J. M. Fox, M.R.C.S., "On the Supply of Water to Rural Districts and the Public Health (Water) Act," to which I should like to refer. After considering the general powers given to rural authorities by this Act, the author, speaking of water, says :—

"The practical questions it appears to me are (1) as to sufficient quantity, and (2) the limitation of cost specified in the Act."

"Much misapprehension, I have been led to think, exists as to the quantity of water consumed in rural households. Accustomed to the large estimates of town requirements, including many purposes for which water is necessary there, but finding no corresponding use in the country, it strikes us with astonishment that three gallons per head per day is an outside estimate for a village consumption. And yet I have proved this by water supplied to villages through a meter again and again."

"Taking the usual average, therefore, of five and a half persons to a cottage, the quantity required for such a dwelling would be about 13¾ gallons." The quantity I considered sufficient in my paper, 12 gallons, is therefore rather small. "Now a cottage, with its outbuildings, says Mr. Wheeler, M.INST.C.E., covers about 500 square feet of ground." I think this is too large, for, although many cottages with their outbuildings undoubtedly cover 500 square feet, a much larger number are considerably smaller, more especially those built in blocks of three or four, and the outbuildings, as a rule, are so rough and the roofs so bad, that the amount collectable from them would be too small to repay the trouble of collection.

"Taking the rainfall at 22 inches per annum, a minimum estimate throughout the country generally, a slated roof will yield 5,700 gallons per annum, equal to a daily supply of 15½ gallons, or very nearly three gallons per head per day." In this calculation only 2·6 per cent. is allowed for loss, which is not nearly sufficient even with a slated roof.

"But the rainfall is, of course, unequally distributed throughout the year. And this brings us to the second question of cost. The cost specified in the Act, at which an authority may make a compulsory order for water-supply to a house is thus defined:—'Not exceeding a capital sum, the interest on which at the rate of five per cent. per annum, would amount to twopence per week.' This represents a capital outlay of £8. 13s 4d, and such, indeed, might as well have been stated in the Act with less circumlocution."

"It is a very unusual drought that extends over two months. But it has become a rule amongst engineers that all storage receptacles, be they reservoirs for towns or tanks for cottages, should not contain less than seventy-eight days' unrenewed supply. Thus a tank for a cottage, covering 500 square feet, would require to be 6 ft. 6 in. in diameter, and 6 ft. deep, and to hold 1200 gallons." Though seventy-eight days' storage may be sufficient in the case of a reservoir for a town where, in the wettest season of the year, a large quantity of water is allowed to run to waste, it is not sufficient, in the case of a cottage

where it is necessary to save all the available rainfall, for although we never have seventy-eight days without rain we frequently have 200 or 250 consecutive days with considerable less than the average fall.

"The cost of such tank is estimated at 1¼d per gallon. Larger tanks may be reckoned at 1d. per gallon. Hence, there is economy in making one tank serve for two or three cottages." This estimate is I believe too low for a properly constructed tank such as I described, but the estimate I gave of about 2d per gallon is, perhaps a trifle high. I also think that it is a mistake to make one tank serve for two or three cottages, for though it is undoubtedly cheaper, the increased size renders the brickwork much more likely to sink and crack, and allow the infiltration of foul water from the surrounding ground.

"At this rate, the cost of the water supply from heaven, independently of all chances afforded by the soil, and stored for permanent use, would be £6. 5s per house, or £2. 8s 4d within the limit laid down by the Act."

"From what I have before said, it follows that I cannot agree with this conclusion, for as I consider that a larger tank would be necessary, the cost would, of course, be greater, and also Mr. Fox makes no allowance for the cost of gutters and pipes, which would have to be provided in nearly all cases. I am, therefore, afraid that a supply in this manner could not be made compulsory, as the cost would, I believe, slightly exceed the limit laid down by the Act."

H. Sowerby Wallis.

Mr. W. B. Kinsey then said Mr. Wallis did not appear to have made any provision for filtering the water before storing it, which, after the remarks by Mr. Symons as to the washing of the air by rain, would seem to be necessary.

Mrs. Amelia Lewis observed that the paper just read was of the highest interest, though it had been put forward in such a quiet and unobstrusive manner. We were as yet in infancy with our knowledge what to do with the natural water supply of the world, and little understood the relations which it bore to our necessities. Rivers had lost their volume, it had been said, by our ignorant waste of trees; while districts had been deprived of natural moisture by over drainage, and droughts been produced by neglect of vegetable life. The saving of rainfall in this instance would benefit thousands, who could not participate in the artificial supply of towns; it was certainly desirable that this natural supply should not only be taken care of, but kept pure by sanitary arrangements. The plan advocated by Mr. Wallis seemed very feasible, only—who was to bear the expense? Mrs. Lewis was afraid that it belonged to the good things, that were a long time coming. Still, nothing could be better than calling attention to the great want of water among cottagers, miles away from towns; and only those who had experienced the shortcomings of this supply in agricultural districts, as she had herself, could understand the vast importance of using the natural supply in a healthy manner for the well-being of a large

part of our population. There could be no doubt that Mr. Wallis deserved the very highest praise for bringing this subject in so succinct a manner before this Section of the Sanitary Congress.

Mr. Baldock considered that Mr. Wallis had rendered a great service to Sanitary Science, especially on behalf of the poorer section of the community, in his suggestions for providing them with an improved water supply. Nothing could be worse than the sources from which, at present, most houses in poor localities, and cottages in country districts, derived their water, and Mr. Wallis' proposal for catching and carefully storing the rain-water from the roof, seemed to him (Mr. Baldock) to exactly meet the case of houses in out-of-the-way places and at considerable elevations, where a regular supply would never be likely to come; it reminded him of a very similar plan adopted by a friend many years ago, of having a large underground tank for receiving tho rain-water, from which it was pumped to wherever it might be required. Mr. Baldock hoped that Mr. Wallis, and others, would continue their efforts in this direction, with a view to the more general adoption of this system.

Mr. T. H. Porter, Mr. Hill and Dr. A. Carpenter also took part in the discussion.

In reply, Mr. Wallis said the first question raised was respecting filtration; this was undoubtedly advantageous, but not by any means necessary; in the case of a house with which he was acquainted, supplied in this manner, it was impossible to ascertain by tasting or ordinary examination whether the water had been filtered or not, and he was afraid that if filters were supplied to labourers' cottages, in the majority of cases they would not be used.

It was suggested thatas a grand national water-supply had been proposed by the Society of Arts, and powerfully supported, it was unnecessary to consider the question; but if the inhabitants of rural districts were to be dependent on their present supplies until that proposition was accomplished, he was very sorry for them. The cost of a water-supply to cottages must of necessity fall directly on the owners, for the occupiers very seldom had sufficient capital, but by a very slight addition to the rent a good interest might be secured on the outlay, and would, he believed, be readily paid.

He thought no other point occurred in the discussion to which it was necessary to refer, but he wished to thank the meeting very sincerely for the kind attention with which his paper had been received and for the vote of thanks.

On some of the apparent influences of the Weather upon the prevalence or otherwise of certain classes of disease.

(*Illustrated by Weather Charts.*)

Having taken a small share for some years past in the compilation of the mortality returns of the Croydon district for the Local Board of Health, by the contribution of the meteorological element, I venture to submit a short paper on some of the apparent influences of the weather upon the prevalence or otherwise of certain classes of disease.

The diseases which I have illustrated are those of the zymotic and the pulmonary class. To facilitate the study of the subject, I have constructed from the Mortality Tables of Croydon, as first published by the late Dr. Westall and afterwards by Dr. Philpot, the Medical Officer of Health, a Table calculated to show at a glance both the annual and the quarterly death-rates from those diseases, also the mean temperature and rainfall for the same times, and extending over a period of 14 years from 1865 to 1878.

In the first place I divide the period of time into equal portions of 7 years each, and compare the averages of one with the other; so that we see what progress has been made, if any, in the control of preventible diseases, and what differences of meteorological phenomena may have been exhibited during each term.

I find that the annual death-rate from *all* causes for the first 7 years, 1865-71 was 20·51 per 1000 living, and for the second 7 years, 1872-78, 18·62, thereby clearly showing an improvement to the extent of 2 per 1000; and the improvement is pretty equally divided amongst the four quarters of the year, the figures being respectively 22·8, 19·1, 20·1, and 21·4 for the first 7 years, and 20·7, 17·4, 18·4, and 18·5 for the second.

I next take the 7 principal zymotic diseases and I find that the average number of deaths per year for the first period was 183, or a rate of 3·6 per 1000, and for the second period 176, or a rate of 2·8, thus showing another improvement, though slight.

Taking the average number of deaths from zymotic diseases per quarter, I find there is a slight increase in the third quarter, the numbers for the first period being 44, 39, 56, and 44 respectively, and those for the second 39, 37, 59, and 41: in the three remaining quarters there is a diminution.

The annual mean temperature of the first period was 49°97 and of the second 50°67 or 0°7 higher.

The mean temperatures of the first and fourth quarters of the year were in the second period as much as 2°3 and 1°2 respectively higher than in the corresponding quarters of the first period. The mean of the second and third quarters remaining nearly stationary.

The mean annual rainfall of the first period was 26·61 inches, and of the second 28·52 inches, or 1·91 inch more.

The mean annual rainfall for the whole period of 14 years was 27·56, or 1·5 of an inch above that of the average generally ascribed to it.

The mean temperature for the whole period was 50°3, or the same as is usually quoted.

The first and third quarters of the year in the second period show a diminution in the amount of rainfall, but the second and fourth an increase; the latter to the extent of $2\frac{1}{4}$ inches.

Now, taking these averages into account, it would appear that, as the zymotic rate was higher on an average when the temperature and rainfall were lower, and *vice versâ*, and that the general death-rate at the same time was affected in the same way, high temperature and large rainfall were most conducive to health.

Perhaps if we take a few instances, we may be convinced of the fallacy or otherwise of the argument, or we may find it clearly proved that no certain rule can be found to apply, or that weather has nothing at all to do with it.

In the first quarter of the first year 1865 we find that the number of zymotic deaths was only 16, and less by 7 than in any other first quarter of the 14 years.

The temperature was *very low*, being only 36·5 degrees, and lower by $1\frac{1}{2}$ degrees than in any other quarter of the 14 years.

The rainfall was 6·32 inches and just above the average of the previous 10 years.

Unfortunately, I have been unable to obtain a return of the number or rate of the pulmonary diseases for that or the following year, but the deaths from those causes in the first quarter were large; for, though the zymotic rate was very low, the general death rate was high.

Turning now to the fourth quarter of the same year, we find a great contrast, the number of zymotic deaths was 90, or at an annual rate of 8·8 per 1000, and has never been equalled in any quarter since.

Of the deaths, 22 were from measles and 38 from fever.

The mean temperature was 44°9 degrees, and above the average; and the rainfall very large, 11·36 inches, 7 inches of which in October followed a rainfall of one day only in September, the total rainfall for the year being 30·51 inches.

It will be advisable to look at the first quarter of the following year, 1866, which was also one of large rainfall, 11·70 inches, and an average mean temperature, and we find 71 zymotic deaths, 22 of which were measles and 28 fever, contrasting strongly with the first quarter of 1865.

High as the zymotic rate was, still it showed a falling-off of 20 deaths as compared with the previous quarter, and the remaining quarters of the year had a rapidly decreasing mortality from that class of disease, notwithstanding that the rainfall of the year was again very large, being over 32 inches.

The mean temperature of the second and third quarters of the

year 1865 was high, with heavy rains, long periods of drought, and an increasing zymotic death-rate; whilst the mean temperature of the second and third quarters of 1866 was low, with a large rainfall and a decreasing zymotic rate.

But the years of deficient rainfall as a rule show the highest death-rate from zymotic disease.*

The highest death-rate from those causes in any of the 14 years occurred in 1865 and 1868, and was 4·56 and 4·3 per 1000 respectively. The temperature of 1868 was the highest in the series, but the rainfall was very low, measles, scarlet fever, enteric fever, and especially diarrhœa being each strongly represented.

In 1869 and 1870 the zymotic death-rate was high, the prevailing complaints being scarlet fever in all the quarters of each year, and diarrhœa in the third of each.

In 1871, in addition to scarlet fever came an epidemic of small-pox, of which 59 deaths occurred in the first three quarters, and none in the fourth. Diarrhœa was also prevalent in the third quarter.

In each of these years, as in 1868, the rainfall was low, and in 1870 very low, the temperature generally ranging high during the summer months.

In 1872, a year with high temperature and a very large rainfall, 35·27 inches, the zymotic rate was much lower than in the previous four years, notwithstanding that measles and whooping-cough were epidemic.

Following this year of excessive rainfall came 1873 with 10 inches less rain, and less than an average temperature, and we find the zymotic death-rate lower than in any other year of the series, being only 1·3 per 1000; the general death-rate was also the lowest, being only 16·93.

During the years 1874, 1875, and 1876, the zymotic rate rose to 2·5, 3·6, and 3·5 respectively, the rainfall being low and the temperature high.

In 1875 occurred a visitation of enteric fever, which had two periods of great activity, as though there were some disturbing causes at work which only required to be removed that the results might cease. The mean temperature was high and the rainfall exceptionally heavy during short periods.

In 1876 and 1877 zymotic diseases were still prevalent, but in 1877 enteric fever died away, the rainfall being large and continuous, and the temperature high.

In 1878, diphtheria, whooping cough, and infantile diarrhœa were prevalent, no less than 60 deaths from diarrhœa, 55 of which were

* In the case of 1865, although the total rainfall for the year was large, being over 30 inches, still it was remarkable for the irregularity of its distribution, and for the smallness in number of its rainy days, for instance, there were but three days' rain in April, giving only 0·17 of an inch, whilst eleven days in May gave 3·40 inches, one day of which having a fall of 1·20 and another 1·10 of an inch during thunder storms. Again, in September there was but *one* day on which it rained, to the amount of 0·27 of an inch, whilst in October there were twenty-three days of rain to the amount of 7 inches.

of infants under one year old, occurring in the third quarter. The atmosphere of that quarter was very close and thundery, with large and heavy rainfall following upon a very large spring rainfall.

Looking at all the circumstances of the case, it appears that years mostly prevalent with zymotic disease are those years in which there have been long periods of dry weather with occasional heavy rains, as in 1865, 1868, and 1870. The chart for the year 1870 I have brought for your inspection.

Those years which have the greatest number of rainy days being those with the lowest zymotic death-rate, as in the present year; the chart for which is before you for comparison with that of 1870.

In 1870 the temperature of the summer was high, and the rainfall very deficient, quite a drought having prevailed, but still there were occasional heavy rain storms with long intervals of drought between, in that year the zymotic rate was high from scarlet fever and diarrhœa.

In 1879 we have had almost continuous rain, and often very heavy, but there have been no periods of drought, and the temperature has been low, the zymotic rate has consequently been low; diarrhœa has been conspicuous by its absence, the low temperature and moist atmosphere being alone responsible for the generally high death-rate, which was principally caused by the great mortality from respiratory diseases.

The rainfall of the present year to the end of September has been 28·03 inches, or 10 inches more than the average, and 2 inches more than the average for the whole year and the number of rainy days 159, or 58 in excess.

The rainfall of 1870 for the same period was but 13·11 inches or 15 inches less, and the number of rainy days 78 less.

This year is the third instance since 1865 of an almost continuous rainfall, resulting in a low zymotic death-rate.

There is one point more I should like to touch upon, and that is, the great difference between the nature of the rainfall of the last four or five years and that of previous years. The falls of rain are much heavier and more frequent than formerly, and I think that much of the unusual prevalence of fever since 1874 has been caused by the frequent exceptionally heavy rains, especially those which occur at night; when, unless there is a distinct and ample provision for storm water, it must enter with great force and volume into the sewers, the lower parts of which become flooded, at the same time that the ventilators in the streets are choked; and forcing the sewer gas to make its escape to the higher levels, it enters the houses placed ready to receive it.

Heavy rains in the daytime do not so much matter, for the houses are open, and it is very seldom that a heavy rain occurs at night which might be called sufficient to produce an epidemic of fever, and which should be at the rate of an inch in an hour.

Such a rain occurred soon after midnight on the 24th of September, 1875, during a violent thunderstorm, when 1·13 of an inch of rain fell in an hour; and as at that time the storm-water was not

CROYDON.

Year	ANNUA DEATH-RA Quarterly. 1st.	2nd.	3rd.	4th	r. h.	MEAN TEMPERATURE. Quarterly. 1st.	2nd.	3rd.	4th.	Year	RAINFALL. Quarterly. 1st.	2nd.	3rd.	4th.	Year.
						°	°	°	°	°	Inches.	Inches.	Inches.	Inches.	Inches.
1865	21·3	18·1	20·8	25·6		36·5	55·0	61·9	44·9	49·6	6·32	5·56	7·29	11·34	30·51
1866	26·9	20·4	16·8	20·9		40·7	53·9	60·0	45·1	49·9	11·70	7·26	8·71	4·71	32·38
1867	21·0	16·6	15·6	19·9	4	38·2	55·1	60·0	41·7	49·1	6·94	5·12	8·86	4·12	25·04
1868	21·0	22·2	24·4	25·2	3	41·4	57·7	64·1	44·4	51·8	6·61	3·03	6·92	8·02	24·58
1869	21·1	19.2	22·7	20·7	2	41·7	53·5	61·7	44·2	50·3	6·89	5·70	5·22	7·57	25·38
1870	23·9	18·2	19·9	19·9	4	38·8	55·3	61·6	42·2	49·5	4·99	1·48	6·64	9.16	22·27
1871	24·3	19·3	20·3	17·7	4	41·0	52·9	61·8	42·6	49·6	5·56	6·91	8·70	3·37	24·54
1872	20·1	17·1	19·8	15·6	3	44·7	53·9	62·0	46·3	51·8	8·74	6·24	7·16	13·13	35·27
1873	19·1	17·3	16·1	16·2	7	40·6	53·4	60·9	44·8	49·7	7·32	5·25	7·10	6·04	25·71
1874	19·5	18·4	16·8	19·4	3	42·2	54·3	62·0	42·8	50·3	3·53	5·27	6·08	9·22	24·10
1875	24·1	20·0	19·4	23·4	2	40·8	54·6	61·6	44·5	50·4	5·18	4·95	8·30	8·44	26·87
1876	22·1	15·8	20·8	17·5	4	40·7	53·5	62·6	47·8	51·2	5·66	3·59	6·16	11·41	26·82
1877	21·0	18·8	15·6	16·9	7	43·1	53·8	59·9	45·5	50·6	9·38	7·35	6·93	8·52	32·18
1878	18·7	14·3	20·4	20·8	7	42·2	56·4	61·9	42·1	50·7	3·73	10·70	7·02	7·26	28·71
1879	22·5	18·3				38·0	51·4				6·56	10·08			
Avg. of 1st 7 Yrs.	22·8	19·1	20·1	21·4	5	39·7	54·8	61·6	43·6	49·97	7·00	5.24	7·48	6·90	26·61
Avg. of 2nd 7yrs.	20.7	17·4	18·4	18·5	9	42·0	54·3	61·6	44·8	50·67	6·22	6·19	6·96	9·15	28·52
Avg. of 14 Yrs.	21·7	18·2	19·2	19·9	7	40·8	54·5	61·6	44·2	50·32	6·61	5·71	7·22	8·02	27·56

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ABSTRACT OF DEATH-RATES AND METEOROLOGY AT CROYDON.

Year	ANNUAL DEATH-RATE.					ZYMOTIC DISEASES.													PULMONARY.					MEAN TEMPERATURE.					RAINFALL.				
	Quarterly.				For the Year.	Total of each per year.							Total in Year.	Rate per 1000	Total pr.Qr.				Total in Year.	Total pr.Qr.				Quarterly.				Year	Quarterly.				Year.
	1st.	2nd.	3rd.	4th		S.P.	M	Sct.F.	Dipth.	Who.C.	F.	D.			1st.	2nd.	3rd.	4th.		1st.	2nd.	3rd.	4th.	1st.	2nd.	3rd.	4th.		1st.	2nd.	3rd.	4th.	
																								°	°	°	°	°	Inches.	Inches.	Inches.	Inches.	Inches.
1865	21·3	18·1	20·8	25·6	20·97	6	24	27		21	52	47	187	4·56	16	25	56	90						36·5	55·0	61·9	44·9	49·6	6·32	5·56	7·29	11·34	30·51
1866	26 9	20·4	16·8	20·9	21·18	5	32	19		29	51 Enteric	25	161	3·6	71	36	30	24						40·7	53·9	60 0	45·1	49·9	11·70	7·26	8·71	4·71	32·38
1867	21·0	16·6	15·6	19·9	18·08	8	1	19		18	15	30	91	1·9	23	19	24	25	153	62	30	17	44	38·2	55·1	60 0	41·7	49·1	6·94	5·12	8·86	4·12	25·04
1868	21 0	22·2	24·4	25·2	21·99	1	39	44 Sct. Fevr.		35	36 Enteric.	55	210	4·3	44	69	77	30	141	43	33	22	43	41·4	57·7	64·1	44 4	51·8	6·61	3·03	6·92	8·02	24·58
1869	21·1	19.2	22·7	20·7	20·93	1	15	86 Sct. Fevr.		24	19	44	189	3·6	30	25	71	61	165	50	36	27	52	41·7	53·5	61 7	44·2	50·3	6·89	5 70	5·22	7·57	25·38
1870	23·9	18·2	19·9	19 9	20·46	11	14	88 Sct. Fevr.		33	18	52	216	4·0	48	38	77	53	176	69	45	18	44	38·8	55·3	61·6	42·2	49·5	4·99	1·48	6·64	9.16	22·27
1871	24·3	19·3	20·3	17·7	20·00	59 Epidemic.	16	32		32	22	63 Epidemic.	224	4·0	76	62	60	26	163	56	43	20	44	41·0	52·9	61·8	42·6	49·6	5·56	6·91	8·70	3·37	24·54
1872	20·1	17·1	19·8	15·6	18·08	5	50 Epidemic.	10		36 Prevt.	24	41	166	2·9	45	41	58	22	137	38	36	20	43	44·7	53·9	62 0	46·3	51·8	8·74	6·24	7·16	13·13	35·27
1873	19·1	17·3	16·1	16·2	16·93	5	5	10		14	9	36	79	1·3	24	9	32	14	145	47	44	17	37	40·6	53·4	60·9	44·8	49·7	7·32	5·25	7·10	6·04	25·71
1874	19·5	18 4	16·8	19·4	18·01	. .	65 Epidemic.	18		24	17	28	152	2·5	29	56	42	25	179	56	35	25	63	42·2	54·3	62·0	42·8	50·3	3·53	5·27	6·08	9·22	24·10
1875	24 1	20 0	19·4	23·4	21·61	1	. .	38	7	45 Epidemic.	90 Enteric.	50	231	3·6	25	55	58	93	205	94	38	23	52	40 8	54·6	61·6	44·5	50·4	5·18	4 95	8·30	8·44	26·87
1876	22·1	15 8	20·8	17·5	19·07	13 Prevt.	13	71 Epidem.	26 Prevt.	24	34 E—Prevt.	46	227	3·5	61	36	79	51	162	52	42	24	44	40·7	53·5	62 6	47·8	51·2	5·66	3·59	6 16	11·41	26·82
1877	21·0	18 8	15·6	16·9	18·08	29 Prevt.	30	5	43 Prevt.	14	25	32	178	2·7	57	37	50	34	181	65	58	23	37	43·1	53·8	59·9	45·5	50·6	9·38	7 35	6·93	8·52	32·18
1878	18·7	14·3	20·4	20·8	18·57	4	14	15	36 Prevt.	39 Prevt.	20	68 Prev. Infts. (3rd Qr.)	196	2·9	34	23	92	47	195	69	31	28	67	42·2	56·4	61·9	42·1	50·7	3·73	10·70	7·02	7·26	28·71
1879	22 5	18·3													33	33				91	61			38 0	51·4				6·56	10 08			
Avg. of 1st 7 Yrs.	22·8	19·1	20·1	21·4	20·51	12	20	46		27	30	45	183	3·6	44	39	56	44	160	56	37	21	45	39·7	54·8	61·6	43·6	49·97	7·00	5.24	7·48	6·90	26·61
Avg. of 2nd 7 yrs.	20.7	17·4	18·4	18·5	18·62	8	25	40		28	31	46	176	2·8	39	37	59	41	172	60	41	23	49	42·0	54·3	61·6	44·8	50·67	6·22	6·19	6·96	9·15	28·52
Avg. of 14 Yrs.	21·7	18·2	19·2	19·9	19·56	10	22	43		27	30	45	179	3·02	38	41	57	42	166	58	39	22	47	40·8	54·5	61·6	44·2	50·32	6·61	5·71	7·22	8·02	27·56

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G. Corden.

cut off from the sewers, and the main sewer was in a very choked condition, I fully believe it was to some extent answerable for the second outbreak of fever that year, which took place about a fortnight afterwards.

I am aware that great efforts have been made by the local authorities since then to cut off all direct communications between the sewers and the interior of houses, and also to divert the surface and storm-water from the sewers; but still much must remain to be done, and until done, and that thoroughly, if the abnormal conditions of the rainfall as of late years exhibited are to continue, so zymotic diseases may rear their ugly heads amongst us.

At the same time there is much to be thankful for in the fact, that zymotic diseases are occasional visitors only, and the general death-rate of the district is very much below that of large towns generally, and frequently below the average of all England.

Geo. Corden.

Dr. Black said that very excellent results had been obtained by the medical officers of health in Scotland from charting the rise or fall of the death-rate from various diseases.

Dr. A. Carpenter said that there was much in the paper which his friend Mr. Corden had read which was important and interesting, especially as pointing out the connection of heat and cold with mortality, and also the connection between heavy and sudden rainfall and the rise of enteric fever. It would be a means of enlightening some upon the evils which undoutedly arose from defective sewers and an impure subsoil, and pointed to a necessity for preventing increase of impurity in the latter. The paper represented an enormous amount of detail work which reflected great credit upon the observer, and will be found of use to the local sanitarian for all time. It would help to prove the point which he (Dr. Carpenter) had always maintained, that enthetic disease was caused by impure air from the subsoil finding its way into houses at night, as well as by means of impure water-supply. It was a reason for all good Sanitarians considering the nature of the material upon which houses were built, and taking measures to prevent the intrusion of foul air from foundations as well as by sewer channels.

As a contribution towards the discussion on Mr. G. Corden's paper on the "Influence of Weather on Disease," Mr. Edward Mawley, F.M.S., exhibited a chart which he explained in a short paper, read by Mr. James Chisholm, entitled "Eleven Months of Cold Weather" (November 1878—September 1879), of which the following is an abstract:—

The weather of the past eleven months had been throughout of so exceptional a character that he thought a diagram illustrating the most remarkable features of it—its low temperatures and heavy rainfall—and at the same time indicating its influence upon the health of the inhabitants of so large a city as London, could not but prove of interest to those assembled for the purpose of discussing Meteorology in connection with Sanitary Science.

Temperature of the air at Greenwich.—The mean temperature of the whole period was 3½ degrees in defect of the average of the previous 20 years. The coldest month (January) being 6°·8 below the mean, and the least unseasonably cold one, March (0°·4) below it.

Mortality in London.—The eleven months were on the whole healthy, the average number of deaths per week being 18 less than is usual. During the first seven months, or in the winter and spring, the deaths exceeded the average of the previous 10 years by 79 per week. Whereas in the remaining four months, or in the summer and early autumn, they fell short of it by as many as 195 per week. July was the healthiest month, the total number of deaths being 1730 less than the average; while March proved the most unhealthy, 1420 persons dying during the course of it in excess of the average number. It should, however, be explained that the latter, although this year the most seasonable of any in temperature, was a month of changable weather, and followed the longest cold period that we have experienced for many years.

Owing to the absence of epidemics of a severe character, the foregoing particulars might be taken as fairly indicating the direct influence of low temperatures, long continued, upon the public health both in winter and also in summer.

Rainfall at Addiscombe, Croydon.—The total fall in Croydon in the eleven months was nearly 9½ inches in excess of the mean amount for the previous 19 years, August being the wettest (4·613 inches), and March the driest (0·559 inches) month. So that the month last named was at once the most seasonable in temperature, the driest and the most unhealthy. Mr. Mawley doubted whether the influence of rain upon health could be traced in the same clear way as that of heat or cold, but considered that the beneficial effects of a heavy rainfall, like that of the last few months, must in large towns, where even the air itself was rendered all the more wholesome by an occasional washing, undoubtedly have been very great.

Diseases of the respiratory organs and zymotic diseases.—The number of deaths in London from diseases of the respiratory organs was in nearly every week of the period under consideration in excess of the average. While on the other hand, with as few exceptions, diseases of the zymotic class had proved much less fatal than usual. The greatest number of deaths from chest complaints occurred in March, and exceeded the average of the previous ten years by over 1000; whereas between the middle of July and the middle of August there were about 1200 less deaths from fevers, diarrhœa, &c., than is usually the case.

Mr. Mawley, in conclusion, expressed the opinion that our Sanitary reformers migh justly claim some credit for the uniformly satisfactory position of that curve on the chart which represented the number of deaths from zymotic diseases, as this curve might be taken as affording a tolerably correct indication of the present Sanitary condition of our giant metropolis.

In answer to Dr. Black, who said that the charts which I exhibited were not referred to in the paper, and who went on to enlarge upon the very excellent result obtained from a systematic

charting of the rise or fall of the death-rate from various diseases, as followed by Medical Officers of Health in Scotland, I said that the charts exhibited were, with one exception, meteorological only, and shown for the purpose of contrasting the temperature and rainfall of the years 1870 and 1879. The exception was the chart showing the means and totals for each month for fourteen years, on which was marked for each quarter the death-rate from zymotic diseases, and each point was connected by a blue line or trace, by which the eye could take in very readily the variations from the mean.

Conditions of the Water Supply of Croydon, in relation to its Rainfall and Geology; with Suggestions for its Sanitary and Profitable Improvement.

In the autumn of 1875, Croydon was visited with a very violent epidemic in the form of enteric fever of the typhoid class. As this form of fever is such as can be very generally attributed to defective Sanitary conditions, attention was vigilantly directed to the surrounding Sanitary conditions by the Local Board of Health; but as the disease continued for a considerable period with fatal effects, it was thought necessary to call the attention of the Government to the matter, and a Sanitary Inspector was sent down from Whitehall, who sat for some time in Croydon to hear evidence and to examine the general Sanitary conditions which might be thought to have encouraged the disease. This ended, I believe, in certain recommendations by the inspector, which were duly carried out by the Local Board of Health.

At the period of this epidemic it became the general public opinion in this district that the spread of the epidemic was due to one cause only, contagion conveyed in some manner through the water supply. This was at the time thought to be very clear, as it was confined, or very nearly so, to the area supplied by the Croydon Waterworks, which covers only a part of the entire district. In this district, amongst others that were supplied, there was one very striking instance in the immediate neighbourhood where I reside. On one side of the Selhurst Road the epidemic prevailed, that is the side that was supplied with the Croydon water; whereas on the other side there were no cases, where the houses were supplied by the Lambeth Waterworks.

Further, Gilhurst Road being a new road, the Sanitary conditions were equal or perhaps a little better on the side supplied with the

Croydon water, as the houses were newer and better built, on plans approved by the Board of Health; whereas many of the other houses on the opposite side were built before the existence of this Board. Further, generally there were no cases in any direction *beyond* the Croydon water supply. As soon as the cause was discovered, housekeepers took the precaution to boil the water used for drinking purposes, and the epidemic disappeared.

At the time, I took some pains to inquire into the general conditions of the water supply, entered into communication with the inspector, and pointed out some Sanitary arrangements that I thought necessary. I am not aware whether these were or were not carried out, but I know that some of these conditions remain. I have since thought the matter seriously over, and I have come to the conclusion that the meeting of the Sanitary Congress in Croydon would be a proper time to bring my ideas of the subject forward, as I feel quite sure that this is the best means of testing their value. I think that it is also in another way a proper time. There is now no epidemic in Croydon, and persons that might have felt excitement at the time, will look on with that dispassionate coolness which is necessary for all scientific investigations, so as to consider the matter in its simple health-bearing conditions for future periods only. Otherwise there was a kind of *stain*, if I may so express it, inflicted upon the purity of the Croydon water at the time of the epidemic, which has not been entirely removed by any important change of circumstances; and I feel that if the subject is now fairly ventilated, that stain may be removed. I have lately spoken of this matter to a gentleman who is present, who tells me that he still has all water first boiled before it is drunk by his family; and other like cases have been given to me; so that if this suspicion exists, it is at least not pleasant in a Sanitary point, and would be better removed.

I will now, if you please, point out the general conditions of the water supply, and consider it in a Sanitary sense.

In the first place, the water supply of Croydon is pumped by machinery from what is termed in the neighbourhood an Artesian well. But the conditions of this well, or rather group of wells, as there are more than one, is so different from the general conditions of Artesian wells, that I doubt exceedingly whether it would be accredited as such by scientific men.

This matter I will now take in detail.

1. POSITION OF THE WELLS IN RELATION TO RAINFALL AND DRAINAGE.

In this matter I must ask you for the time to neglect all conditions of the soil (which we will hereafter consider), and take the conditions of the surface relatively to drainage by levels only. This is in a certain degree necessary. A great extent of surface is covered by roads, paths, buildings and paved spaces, so as to permit surface drainage only. Further, soils which are in degree

permeable to water, and permit the ordinary rains to be entirely absorbed, will in case of storms or in very heavy rains drain off a very large portion of the water by surface drainage, only to the lowest contiguous levels. For the general condition of surface levels, as regards the position of the Croydon Waterworks, I have here one of the six-inch Ordnance maps of the Croydon district. By following the bench mark at the position of the waterworks in Surrey Street, we find one near with a reading 162·9; this point would be then approximately 163 feet above mean water at the sea coast. I have in the diagram taken this for our starting-point, and have coloured this lowest point of the surrounding district dark blue, and have extended this colour over all the district that lies as low as or lower than this, according to the bench marks. I have made the next level somewhat lighter, to include all surfaces of 180 feet above datum line, that is 17 feet above the level of the waterworks. The next 200 feet, or 37 feet above. The next 250 feet, and the next 300 feet and upwards; shading this off where it goes to 400 feet to white, so that the diagram fairly represents by jumps of 17 feet to 50 feet the natural surface drainage of the district. I have shown by very dark blue the River Wandle, which collects the surrounding drainage as a considerable stream, and conveys it to the Thames.

By this diagram it appears that the position of the Croydon Waterworks is near the bottom of a large valley extending over an area of about perhaps six or seven square miles, of which this part of the neighbourhood forms the natural drainage outlet. This position has possibly been in an old water way draining a much greater area, of which the sharp declivity represented by Crown Hill, taking the direction north and south of the High Street, has been one of the banks. The corresponding opposite bank passing at the foot of the range of hills towards the south, of which Park Hill, the Waldrons, and Duppas Hill form a part. This may be clearly seen by the lines of shading. The conditions of the above as regards the rainfall of the higher immediate districts would be that the surface drainage would be for a large part constantly directed towards the point occupied by the waterworks; so that what danger might be derived from solution of effete surface matter in such a system would depend in a large degree upon what means were taken to avoid its intrusion into the water-supply system. But under any conditions, it would be brought into such contiguity by its natural flow, as to be dangerous in a Sanitary sense. To this matter I will return after briefly noticing the geological conditions.

2. POSITION OF THE WATER IN RELATION TO THE GEOLOGY OF THE DISTRICT.

The town of Croydon and the surrounding district is situated mostly upon the outcrop of the series of beds known as the lower tertiaries of the London basin. The outcrop at Croydon is at a great angle to the lines of stratification, as we find the whole series of the lower tertiaries consisting of Thanet sands, Woolwich and

Reading beds, and the Oldhaven beds, brought to the surface in the small space of a mile north and south; as we find at Addiscombe a broad area of London clay, and at South Croydon, Coombe Cliff, and the district which lies north-east of it, the chalk or upper cretaceous. Now, this series of beds are all of porous structure—in fact, water-bearing beds, and if we sink to any depth through these surface beds, as soon as we find a retentive soil, even as retentive as that of the chalk, we may expect to obtain a fair water supply from the surface drainage alone.

That this has been a course of ancient drainage, we have direct evidence in the very shallow representatives of the lower tertiary series in the immediate position of the wells. In the lower tertiaries particularly the large development of the Oldhaven series which we find in the adjacent Shirley and Addington hills, of 100 ft. or so, and Woolwich and Reading beds, which are also fairly represented in the district, and the Thanet sands also, which together, at the lowest estimate, must at some time have formed a stratum 200 ft. to 400 ft. higher than the present level: these are denuded and washed away until they are represented in coarse gravels only by about 10 ft. above the chalk. This is seen in the section of the well which I have drawn from particulars given me by Dr. Buchanan in a letter, December, 1875.

At a later period the upper tertiaries have cut through the London clay and the older tertiary series, and have left a very thin channel of the valley gravel (in which we commonly find the remains of the elephant and mastodon elsewhere) nearly north and south over the same area, but at right angles to it, as is shown by the red space marked on the map; so that under the later tertiary period there was still an area of drainage, and the River Wandle, formed originally possibly on a cretaceous fault, has existed as a river throughout all the period that dry land has prevailed in the district since the chalk period. Under these conditions, Croydon would be naturally a district favourable for easy and copious water supply; at the same time, also, especially under the influence of surface drainage, from the direction of ancient water-ways.

I have coloured a map which gives the geology of this district as nearly as I could from data to my hand. It will be only so far in error that I cannot exactly estimate the extent of the separate beds of the lower tertiaries; but as they are entirely of one porous structure, it will not materially affect the subject of this paper.

I have also constructed a section which will extend from the clay to the chalk. I have in this section represented the strata of regular outline, which would be naturally produced by a district of even flexure of upheaval to the south of Croydon. These would be the general indicated conditions, but there occurs a fault in the general series of a band of blue clay in the cretaceous series, which I have marked by a black line in the section of the well, which indicates that the chalk is not as originally deposited. We also find that at ten feet down the one side of the section, for seven feet chalk, and the opposite side gravel. This either indicates an old cliff, whose angle would most probably extend much further, or more probably

a fault, which makes altogether, with the general surface outline, one suspect that the fault is continuous, at about a line in which the waterworks forms a point in the direction of the older tertiary valley.

The general influence of such a fault would be to create a special line of surface drainage, which would be prejudicial to the certainty of obtaining pure water at this point free from surface drainage.

SUMMARY OF THIS CONDITION.

To bring this matter generally under consideration, we find that by natural inclination of the surrounding land, particularly to the north-east and south, we have a fall in the district towards the position of the wells, and that naturally the porous strata above the chalk would, in case of considerable rainfall, saturate this strata. As the strata above would also contain the drains of the district, and every species of refuse general to the surface soil of a populous neighbourhood—as we know, when our dog or cat dies, it is buried in the garden. Further, we have not always possessed the important advantage of a Local Board of Health; so the system of drainage that we now criticize was built upon a system in old Croydon which dates earlier than the celebrated invention of Drummond, who gave us the means of keeping our inland towns much more wholesome by the pollution of our streams and water courses.

Now, such a state of surface affairs in a district of a deep sinking in the ground for potable water, does not appear to be extremely wholesome. It may be argued that one well is bricked up, and that another is lined with iron casings; but as hydraulic pressures are rather difficult things to manage, even when all parts are visible, it would be clear to many who have had dealings with this subject that it would be a great difficulty to keep an area pure surrounded with such influences.

Brick and concrete are porous materials, and iron is subject to decay by perforation in small holes. Further, it is difficult to join any large masses of metal, and impossible to test if the joints are secure when joined. So that if there is an imperfect joint under hydraulic pressure at A in the diagram, there is the greatest possible probability that the water at A would reach B.

POSSIBLE SANITARY INFLUENCE OF SUCH CONDITIONS.

I do not profess in this matter to look at things very squeamishly. I clearly understand that I am myself a chemical compound endowed with organic functions. I look also on water as another chemical compound necessary for my existence; and so long as this does not possess matters injurious to my system, I look at it chemically, and do not particularly care for its source. For instance, I have found the Lambeth water with which I am supplied sufficiently pure not to have injured me. Sometimes I have looked at a depth of it in my bath, and from the extremely yellow tone, as also from the doubtful sediment in the cistern that supplies the bath, I could wish it purer. I know also that by the aforesaid invention of the celebrated Drummond, that there is a perfect

circulation by means of the great vital source of the metropolis—the Thames; that a part of the same water that flows from my house-drains will be again supplied to me after it is passed through the great vein of our local terrestrial system, and becomes again the arterial water for our existence, through the complicated agencies of the Lambeth pumping-engines, the sand filter, exposure to air in the reservoirs—which resembles, I presume, the exposure of the animal blood to the air in the lungs—and the influence of organic life in the reservoir, together with the close area of wholesome iron pipes, which will deoxydize any organic acidulous ferment; so that I can well imagine that any injurious matter that possessed an organic constitution would have decayed and become innocuous to my system before the water reached me. On the other hand, I should somewhat fear the most pellucid water taken directly from the earth where the deleterious influence of surface drainage might intrude itself every wet day, even sparingly, but to be immediately taken into my system without the preparation of any circulating system of purging agencies whatever.

What may be the agency by which epidemics spread I do not know. We have in this matter some very striking cases, which lead to the extreme probability that these diseases are organic. This is apparently the case with diptheria; it is thought to be so with cholera, where *torulæ*, not unlike the yeast ferment, have been found to be present in many cases in the stomach and fæces. In these cases, from the nature of fungoid growth or ferments, as they are termed, I do not think it probable that such forms of life are propagated in water; or even probable that such organic life could be preserved for a long time in this medium. But in a surface soil surrounded by the habitations of man and animals, there will naturally be those decaying matters which may form food for its propagation; and, if there is also surface drainage, the germ of reproduction will be washed away, and will probably retain its low character of life for a certain short period, until it is carried to a suitable soil for its propagation, which may be the human body, or other, according to the nature or constitution of the germ; for it is quite certain that germs that can live in one system will not live in another; in the same way that we find blights affect one species of vegetable life and not another, as we see in a very familiar instance: a cherry-tree will be affected by a blight, which will in no way affect a plum-tree. I offer this very brief sketch, and I must leave all details to our more competent medical men, and proceed at once to

SUGGESTIONS FOR THE SANITARY IMPROVEMENT OF OUR WATER SUPPLY.

Here we have at once, by reference to the mode in which the filthy sewage and chemical contamination of tanneries and other manufactories slushed backwards and forwards by the tides in the Thames, becomes, if not perfectly wholesome, at least not seriously injurious water. And if we followed the system by which it is

purified very roughly, we could expect no deleterious effects from the small amount of injurious matter that could possibly enter our wells. But this would be really superfluous. It is quite clear to my mind that by simple exposure in a reservoir for a few days, the prevalence of organic life in the reservoir, of a type not injurious to the human system, vegetable and animal, would speedily clear it of any germs it might contain. Such species alone, as the abundant wheel animalculæ which apparently consume every organic substance small enough to enter their system, would be nearly sufficient. By further refinement we should only need a second reservoir for immediate supply, with an ordinary trenched sand-bank filter, which would last for a great number of years, with our visibly pure water.

ECONOMY OF THE SYSTEM AND VALUE TO THE NEIGHBOURHOOD.

I will now point out the possible position and economy of such a system as that I propose.

By the present system water is pumped directly from the wells to supply the houses, consequently the supply is required at certain hours of the day abundantly, and at other times naturally a very small quantity would be used. For instance, in dry weather a large quantity of water is required to water roads and gardens, whereas in wet weather much less is required. It is true there is one small reservoir; but this is at such a great height, about 200 ft. above the pumps, that pumping to such a height would be entirely waste of power for the supply of the lower districts, and besides this reservoir is too small to be useful. Now every one who is connected with steam machinery knows that any intermittent use is very wasteful from the loss of heat by letting down and bringing up fires. Therefore the same engine with sufficient reservoir space would probably raise more than double the amount of water at the same expenditure, if kept in constant action night and day. So that for the absolute quantity raised, there is no doubt that it would be much more economical to keep the engines, or part of them, at constant full work, or as nearly so as possible.

In the next place, there is a large densely populated district, that in which I reside, of houses supplied at a very high rate by the Lambeth Water Company. The high price is possibly necessary as the expense of purifying the Thames water is very great, and the distance, ten miles or so, to be conveyed in pipes is very expensive. I pay for my house, rated at £45 per annum, a water-rate of £5 per annum; this is, I believe, at about three times the rate that Croydon water is supplied. There are in my immediate district—say, 1000 houses, supplied by the Lambeth Waterworks at an average of £3 per house; this would represent a gross income of £3000, which capitalized would represent, at 5 per cent., £60,000, or more than sufficient to purchase land and construct the necessary reservoirs and pay all outstanding compensations to the Lambeth Waterworks, who are now, by the growth of neighbourhoods in Surrey, experiencing more and more difficulty in providing a

necessary supply. And the same changes could render the water supply wholesome for the whole district.

For this improvement I suggest Croydon is in every way adapted naturally without serious expense.

In the north, through the district of Addiscombe and part of Selhurst, there is abundance of land in the London clay, the most economic of all materials for the construction of reservoirs. Besides which, should in this area more water be required by the growth of the neighbourhood, this is the proper position to sink wells or bore, as the retentive surface-soil will not permit surface-drainage through this capping of clay. Therefore perfectly innocuous water could be drawn from the lower tertiaries direct, which I have no doubt, from the extent exposed of the Oldhaven beds of Shirley and the surrounding district, would give a large supply. But should more pure or Artesian water be desired, this district is so nearly on the border of the London clay deposits, that the green sands could be reached at much less depth than at positions deeper in the London basin in its northward extension, and the purest of all waters be obtained.

WM. F. STANLEY, F.M.S.

Dr. A. CARPENTER said he had listened to Mr. Stanley's paper with some degree of interest, and would, with the President's permission, make a few remarks upon the points put forth by the reader. Mr. Stanley reminded him (Dr. C.) very much of Balaam the son of Beor, who, when called upon to curse the children of Israel, ended by blessing them entirely. Mr. Stanley makes grave charges against the Croydon Board of Health for distributing water from a dangerous source of supply, but asks them to let him have a share of it at Norwood. He is evidently not afraid of the possibility of impurity entering in at the fault which Mr. Stanley thinks to be present in the chalk at the point at which the well is sunk. Dr. C. would, however, point out that the fault, if it exists, is only a few feet from the surface, whilst the well itself is at least 175 feet deep; a fault of the character indicated could not therefore affect a well which is completely protected by iron cylinders to the very bottom of the bore hole; and, indeed, Mr. Stanley indicates his disbelief in his own theory, for he asks the Local Board to let him have the water, as being far superior to the supply which he (Mr. S.) obtains at present from the Lambeth Water Company. So much for the chance of infection from surface-water by the fault to which Mr. Stanley draws attention. Mr. Stanley says that the epidemic of 1875 was due to one cause only. He (Dr. Carpenter) demurred to this; the cause in the first place was typhoid excreta retained in defective sewers; the fact was known and pointed out at the time when it was proposed to give an intermittent supply of water to the town in the day-time. He (Dr. C.) at once said, "If you do, you will have 1000 cases of fever, because the water supply itself will become generally contaminated." He was laughed at by some of the members of the Board, and denounced in the local press; the intermittent supply was given, and 1260 cases of fever was the

result. Of these cases many arose in consequence of water contamination derived from defective pipes and water-closets in immediate connection with empty sewers; but a large part of these were caused also by exhalations from the very defective sewers which existed in all parts of the town. Indeed, it is probable that if the latter had not existed the contaminated water would not have produced anything like the fatal results which followed. He held that it was fully proved that in a majority, if not in all the cases, defective sewers existed, and the air of the houses in which the victims resided was fouled by sewer air before the typhoid germs were distributed in the water supply. I feel quite certain that the water supply, as derived from the well, was pure at its source, but that it became contaminated in the process of distribution, and I make this statement because the water was proved to be fouled at one time and at one place, when it was proved to be pure in another at the same time. Nothing could be more convincing as to this fact than the evidence obtained at the Friends' School in Park Lane. The water, as supplied to the boys, smelt as it came from the tap after an intermittent supply had been obtained. It supplied the boys' bath, then filled their cistern, and, after that the girls got a quantity. The boys had complained of the water. *They had fever.* The contaminated water was washed out of the pipes, and the girls got a pure supply, and they did not have fever. He knew of several similar instances which convinced him at the time that the contamination arose after the water left the bottom of the well. Mr. Stanley might rest assured that no surface water, as such, found its way into the well at all, and that no water was supplied to the inhabitants which did not go through a very solid and definite portion of the chalk formation. There was an idea among some half-informed people that chemical analyses could not detect the presence of mischief in water. He, however, contended that no purer supply existed than that obtained from the Croydon well, and so long as chemical analyses such as those afforded by Professor Wanklyn, were to be obtained, no one need fear to use the Croydon water, and that it was not necessary to boil it before using it. It is true that boiling diminished the hardness, but it is in the hardness that its safety from typhoid germs depends. So long as that hardness is under twenty degrees, so long is the water not supersaturated with lime, and until you have a carbonic acid atmosphere in the water, you will never get a multiplication of typhoid germs, because it is by aid of free carbonic dioxide that typhoid, or any other of that class of germ, can increase and multiply. If they cannot multiply they cannot continue to exist, and mischief must abort. So long, therefore, as carbonic dioxide is fixed by the lime and the hardness is not in excess we never need fear the presence of such mischievous germs in our water supply. I must, however, counsel the Local Board to be on their guard against the time when the population will overtake their power of supply. They ought to prepare for this, and I advise that frequent analyses of the water be made, and when that analysis shows a perceptible amount of albuminoid and free ammonia, with an increase in the chlorine, it will

be time for them to think of changing their source of supply; but until then I strongly advise them to let well alone. I am satisfied that chemistry will be able to direct them most fully, and they ought to consult the chemist more frequently than they do. But for a very long time to come, indeed so long as the supply continues to be only half that at which it is fixed by Mr. Lucas, we need be under no serious apprehension of mischief arising in the manner which has insisted upon by others as well as Mr. Stanley. If ten million gallons per day are available, and we take less than three millions, we are quite safe.

Mr. W. Barns Kinsey said, "I agree with Dr. Carpenter that periodical analyses of well water are necessary, particularly in certain formations, and I can endorse Mr. Stanley's remarks as to the possibility of drawing down surface water at the back of the well lining, and so contaminating the well if the bore-hole is pumped too hard. I have known this to happen in several instances."

Mr. Baldock would not dispute Mr. Stanley's geology, because the geology of Croydon was pretty well known and understood; but he could not allow the statement, that the wells from which the Croydon water was obtained were in any way connected with a recent outbreak of typhoid fever, to go unchallenged. Years ago the Bourne was charged with spreading death and destruction, when the true nature of that extraordinary flow of water was neither known nor understood; no one, however, would now think of attributing to it any such absurd fatality; so, too, the Croydon wells had been blamed, and most unjustly so, with being the cause of typhoid epidemics; but as with the Bourne, so with the wells, the time would come when the error would be discovered, and the wells acquitted. True it was that the *water* had been the innocent agent in spreading the fever, *in course of its distribution through the mains*, but the *real cause* was to be found in the disgraceful sewer system which then, and to a great extent now, underlies some parts, especially the older parts, of the town of Croydon, no better proof of which could be found than in the fact, that once started the fever spread rapidly, bad smells and tastes being observed when the water was drawn from the taps, indicating clearly the connection between the sewers and the water-pipes, *no such taste or smell ever being observable at the wells*, the water from which had repeatedly been analyzed by Dr. Odling, Dr. Frankland, and Prof. Wanklyn, and declared to be unequalled for purity; it was therefore a gross libel on the Croydon water to blame it for what was really caused by the sewers, which were badly laid, broken, and uneven, thereby becoming sewers of deposit, and the source of all abominations. When these sewers were put in order, and *all connection severed* between water-pipes and sewers, drains, and closets, and when, moreover, the supply of water was, as it had recently been made, constant and not ever intermittent, then no more would be heard of the Croydon water propagating fever. As to surface water finding its way into the wells and contaminating the water so as to produce fever, Mr. Baldock considered that this statement had only been

put forward to draw attention off from the sewers, and had no foundation in fact; at any rate as now constructed, all entrance of surface water was, he considered, an absolute impossibility. The question of an *additional* source of water to meet a great increased demand, might arise some day, and then the question might be considered whether that source should be remote from the present one, but for the present, if far less than one-tithe of the money which had been so absurdly talked about for removing the whole of the present waterworks' machinery (to where?), were spent in perfecting the sewer system of Croydon, a great and undoubted Sanitary result would accrue to the town.

Mr. Hill, Mr. Cowper, Professor Wanklyn, and Mr. Lucas also took part in the discussion. The President closed the discussion by stating he agreed with Dr. Carpenter, that more storage power should be obtained by the Croydon Local Board of Health.

Mr. Stanley, in reply to Dr. Carpenter and Mr. Baldock, said, "I cannot understand the Doctor's argument that water can come from the distant parts surrounding Croydon when the surface soil up to the wells is indisputably equally porous to the distant parts. Further, for the value of chemical analysis, I do not think that disease germs, which are invisibly small, and in such minute quantities, would be possible of detection by any chemical analysis—at least, they have never been so detected at present. With regard to sewage entering the supply pipes where the hydrostatic pressure was opposite, and not entering the well where the hydrostatic pressure of surface drainage would be direct, certainly does appear to me a most remarkable argument."

Dr. Carpenter pointed out that it had not been contended that the sewage entered the pipes when the hydrostatic pressure was *opposite*, but that it took place when the pressure was *taken off* in consequence of the supply being made *intermittent* instead of *constant*. He quite agreed with Mr. Stanley that there was little chance of sewage entering the pipes when the supply was constant, but it was just because it had not been constant that the disaster had occurred.

LECTURE.

SANITARY FALLACIES.

LECTURE.

Sanitary Fallacies.

Professor Corfield delivered the following lecture at the second evening meeting :—

Sanitary Science, properly so-called, is a branch of medicine, or perhaps I should rather say, a sister science to pathology, for it is the science which studies the causes of diseases, and its place among the sciences is between those of physiology—the science of life,—and pathology—the science of disease. We see, therefore, how it is that sanitary science, or hygiene, could only become a science in quite recent times, as it was impossible that it should be scientifically studied until physiology and pathology, upon which it is based, became scientific themselves. The more a branch of knowledge approaches to the character of a true science the more readily are fallacies detected, although even in the highest science, the most certain branch of human knowledge—mathematics,—in connection with which one would think no fallacies could exist, these are still to be found keeping their hold upon the minds of a certain class of investigators, as witness ;—the supporters of the theory that the earth is flat and that the sun goes round it, the circle squarers, and the searchers after perpetual motion. If in the highest and most perfect science the power of fallacies does not cease to exist, can it be wondered at that in the youngest, which I will not, however, call the most imperfect, although fallacies which reigned triumphantly while it was yet only an art—the art of preserving the health—and before it became really worthy to be dignified by the name of a science, have been exposed, there are still many others which have a certain, and in some instances a most important influence upon the mind of large masses of the community ?—An influence necessarily for evil. On the other hand, I must point out at once that what is necessary and inevitable in one generation, or at one period of time, may be a mischievous fallacy at a future period and in an advanced state of knowledge.

The history of Sanitary Fallacies is, of course, intimately bound up with the history of the art of preserving the health, and this is as intimately connected with the history of medicine, and indeed, with the history of the world. Among all ancient nations, as well as amongst savage tribes at the present day, we find that the offices of priest and medicine-man were united in the same individual. This was necessarily and inevitably the case, as the priests were in early times the most learned, nay, often the only learned among the people, and they found it expedient to enforce their spiritual rule by keeping secret the means they employed for the alleviation of disease, and not unfrequently by prostituting their knowledge to make the ignorant believe that they had the power of calling in supernatural agency. Among the Greeks in the earliest times Æsculapius, the priest-physician, was said to be so successful that he raised men to life. He was afterwards deified, and it is fitting that Hygeia, the Goddess of Health, should have been one of his daughters. The secrets of medicine, preventive and curative, remained with his descendants—a race of medical priests known as the Asclepeiades—until one of them, the seventeenth in descent from Æsculapius, Hippocrates, the father of medicine and the father of hygiene, gave them to the world in his most remarkable treatises. These works are as truly works of hygiene, or preventive medicine, as they are works of curative medicine, and indeed, it would be difficult to imagine a better or more comprehensive title for a work on public health than that of the celebrated treatise of Hippocrates on "Air, Water, and Places." Hippocrates may fairly be said to have been the founder of the rational method of studying the causes of disease—a method which we, 2300 years after the time when he flourished, have found out is the correct one.

But it was not so long before a great fallacy arose and divided the disciples of medicine into two rival parties. In the Alexandrian School, of which Herophilus (who divided medical science, or medical knowledge, into three branches: (1) Dietetics; (2) Medicine; (3) Surgery; thus assigning to dietetics, or as we should call them, "personal hygiene," the first rank among the medical subjects) and Erysistratus were the lights, there arose a set of thinkers, the Empirics, who struck at the root of the rational pursuit of medicine, by maintaining that the study of the body and its actions, and of the influence of medicines upon it in a state of health were either not possible, or if possible, were not necessary. This school of Empirics, founded in Alexandria in opposition to the teachings of Hippocrates, has existed ever since—exists at the

present day, and has to answer for a great deal of the distrust that exists in the public mind in connection with the rational study of medicine, and the rational teaching of sanitary science. The doctrines of Hippocrates were, however, promulgated in the Roman school by Celsus, and by Galen of Pergamos, who settled in Rome, and became physician to the Gymnasia in the 2nd century after Christ. Galen was a very learned man. He wrote much, and his doctrines held such sway over the medical world, that in the middle of the 16th century the College of Physicians of London insisted upon a recantation from one of its fellows, who had on certain points disputed the authority of Galen. Nothing can show more clearly than this how little was done in the promotion of the rational study of preventive medicine between the 2nd and 16th centuries after Christ. Indeed, after the treatises of Galen, and the works of a few great Arab teachers, there are few of any great importance until we come to modern times.

But before we pass to the Middle Ages, when fallacies reigned supreme, and when their results were most terrible, let us stop for a moment to consider whether there were not writings as old, nay, far older, than the works of Hippocrates, in which the rational practice of preventive medicine was laid down in a manner that could not be mistaken. In that country which was the cradle of the sciences, from which Europe derived the knowledge of numbers and of written characters, and the learned inhabitants of which were calculating and predicting eclipses, when our ancestors were hunting the wild boar and painting themselves with woad—in lower Egypt—a scheme of sanitary medicine had been devised, which must produce in all thoughtful persons who read it with care, a feeling of the greatest astonishment, and of profound admiration. These regulations we have handed down to us in the works of a man who was "learned in all the wisdom of the Egyptians," Moses the law-giver of the Jews, and only to mention one point in illustration of what I say, I will instance the sanitary treatment of a case of communicable disease as described in Leviticus, chap. xiii. and xiv. There isolation of the sick person is prescribed, and not only so, but the isolation of all doubtful cases is even insisted on. After recovery, the most careful cleansing of the person, including even the shaving of the head, the beard, and the eye-brows, and the purification of the clothing, is enjoined. He who comes into the house is unclean. He who lies in it, or eats in it, is to wash his clothes. Then disinfection of the house is provided for, and should the plague break out again in the house, it is to be destroyed. Garments which have

the plague on them are to be disinfected by the best disinfectant known at the time, the best disinfectant we know of now, and the best disinfectant that ever will be known—they are to be burnt. But in this instance, as is well known, the functions of medical officer of health and of priest were united in one person, and however necessary, or even advantageous this might be in an early state of civilization, a similar unnatural union produced most disastrous results in succeeding ages.

In the Middle Ages "when light and learning gave place to darkness and superstition, when truth and honesty were superseded by falsehood and imposture, when reason and experience succumbed to barbarism and bigotry," the priests and the monks were the physicians and the Sanitarians; and it can be hardly wondered at that the priestly functions threw the others into the background, and that, as Dr. Davies, whom I have just quoted says:—"Reason and experience were *wholly* discarded, the use of the ordinary means was *completely* eclipsed by the miraculous power of tombs and relics, of saints and martyrs, of holy water, charms and amulets; and that *each and every portion* of the human frame (however diseased or afflicted) was assigned to the guardianship of different Romish saints." During these ages learning was preserved and increased by the Nestorians and Arabs in their schools at Dschondisabour, Bagdad, Cordova, &c., for which the works of Hippocrates and Galen had been translated by Nestorians and Jews; while in Christian Europe, during these dark ages, the one single spot of light was the school of Salernum, where was published a remarkable work entitled "Regimen Sanitatis Salerni," a translation of which, described as "The most learned and judicious directorie or methodical instructions for the guide and governing the health of man," was dedicated to "The High and Mighty King of England, and published (by consent of Learned and Skilfull Physitions) for the benefite of all in generall," in the year 1617.

This grand fallacy, the mistaken union of theology and medicine, continued through mediæval times, and as late as the year 1511, Henry VIII ordered that physicians and surgeons should be examined by a bishop or vicar-general, with the assistance, it is true, of "such expert persons as they shall think desirable," while the power of granting the degree of Doctor of Medicine remained in the hands of certain high ecclesiastical dignitaries, to a much later period, even if it does not nominally exist now. Through all these dark ages, when the principles of preventive medicine laid down by Hippocrates, Galen and Celsus, were unknown to the multi-

tude, and untaught and unpractised by those whose business it was to teach and practise them; when (more shame to them still) the regulations laid down in that Book of which they were the jealous guardians, to which they alone had access, and of which they proclaimed themselves the expounders and the teachers, were neglected as completely as if they had never been ordained; filth reigned supreme, the dirty houses were crowded together in narrow streets and courts; the rushes which formed a carpet for the floors were never removed, but piled layer on layer, forming a series of filthy strata often many years old; no attempt was made to check the spread of infectious diseases by the isolation of the sick, or by any of the other methods prescribed by Moses; and what was the result? In those ages, and the succeeding ones—the partakers too in the results brought about by this lamentable and gigantic fallacy—plagues held triumphant sway. In the 14th century, the Black Death, after travelling over the Eastern part of the Old World, reached Europe, and soon arrived in England. It spread over the whole country, and caused such a frightful mortality, that only a tenth of the inhabitants are believed to have remained alive, while "Europe is supposed to have lost an aggregate of 40,000,000" (Dr. Guy). As I have pointed out elsewhere, the only people whom this disease seemed to spare were those who, however imperfectly, followed the regulations prescribed by Moses, the Jews, whose immunity was so marked, that they were accused of spreading the disease by poisoning the water, and were burnt alive by thousands in various parts of Europe. The Black Death re-appeared as the Oriental Plague during the 16th and 17th centuries, and the last time that it appeared in England, in the year 1665, it killed between 70,000 and 80,000 persons in London alone.

But besides the Oriental Plague, a frightful prevalence of other diseases, some of which, as the "sweating sickness," are now unknown, while others, as typhus, scurvy, influenza, dysentery, cholera, and even smallpox, have lost much of their terror, must be included among the consequences of the fallacy which had overspread the world. This fallacy was removed by the gradual divorce of medicine and theology, and the 17th century which had seen the last of the Oriental Plague as far as England was concerned, saw anatomy raised to the position of a science, by the labours of Vesalius, of Eustachius, of Fallopius, of Malphighi, of Glisson, of Sylvius, of Willis, and of others, almost all of whose names are worthily preserved for ever in the names given to various

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parts of the body, and saw physiology receive the grand impetus given to it by the discovery of the circulation of the blood by William Harvey, and scientific chemistry begin gradually to emerge from the Arabian Alchemy.

Thus began again the reign of rational medicine, and from that time to this, the study of methods for the prevention of diseases has been pursued, and in many instances with remarkable success. But although we have got again into the right path, there is, as may be expected, seeing the short time that we have been in it, a vast amount of ignorance prevailing in connection even with the rudimentary principles of Sanitary Science, and the ignorant multitude are too often led astray by specious fallacies, propounded with some show of reason and often with great bombast, by persons who have no right to speak with authority on such matters at all, and who are at best "blind leaders of the blind;" but this we may rest assured will always be the case, as is shown by the example of mathematical science that I have already instanced. All that we can do, therefore, is to point out such fallacies as they arise, and to warn those who are in danger of being misled by them.

Against all Sanitary improvements whatever, we find one argument continually brought—that things have gone on in the same way for many years and there is no reason why they should be changed, that our forefathers from generation to generation lived under unsanitary conditions, and why should we not do the same? that cholera, or enteric fever, or diphtheria has never broken out in a place, or in a particular house, and so it need not be expected! Such are the forms in which this argument meets us at every turn, but those who use it forget that our forefathers died in those places; they forget that in all places which have been made cleaner, from which refuse matters have been removed more speedily, where over-crowding has been abated, where more efficient drainage arrangements have been carried out, the general death-rate has been lowered. When they say that because such a disease as enteric fever has not appeared in a place, therefore it never will; they forget that when cholera or enteric fever is introduced into a place where the conditions are favourable for its spread, where the air is tainted and the water-supply rendered impure with excremental pollution—that in that place, although such diseases may have been absent for so long that their existence has been almost forgotten, they will spread like wildfire and decimate the population. They forget in fact that people who are

living in the midst of general unsanitary conditions are in a worse plight than people living in the crater of an extinct volcano, for not only may any one of the severest epidemic diseases break out among them at any time, but they are continually sacrificing unnecessary victims to the demon filth. I have mentioned some of the communicable fevers. Now what I believe to be an important fallacy still exists in connection with the poisons of these diseases.

It was formerly thought and was maintained by Trousseau that the poisons of these diseases might originate anywhere, at any time, under suitable conditions—the specious argument being that having arisen somewhere, at some time or another, there is no reason why they should not originate anywhere or at any time. Without entering into the vexed question of the nature of the poison of such diseases, I will merely point out that this belief is now almost universally scouted with regard to the majority of such diseases. How many persons are there who believe that smallpox or scarlet fever, measles or whooping-cough, arise independently of previous cases of these diseases, and yet we find not a few, supported by the weight of great authority, who believe in the spontaneous origination of the poisons of typhus and enteric fevers, of diphtheria and of cholera. The arguments brought forward to support this position are most of them fallacious in the extreme, and I am bound to say that the arguments advanced to prove the *de novo* origination of the poison of enteric fever, are of themselves sufficient to render it in the highest degree improbable. They are indeed so weak that no one really capable of judging the value of a scientific argument, could from them come to any other conclusion than that the position was untenable. But a practical and very serious mischief has arisen from the spread of these doctrines. We are told that enteric fever is not contagious, and we are told distinctly in so many words that it is rarely if ever communicated from person to person : we are told that in the great majority of instances the poison of this disease originates *de novo* in decomposing excremental filth ; we are told that the intestinal discharges of patients suffering from this disease do not contain the poison of the disease, although they may be more prone to the special decomposition by which the poison is produced, and the result of all this is that a large number (I will not say the majority, for I hope it is not so) of the medical practitioners throughout the country, take no pains to destroy the poison of this disease at its source—the virus-laden discharges of the intestinal canal. It might be thought

that after people were told that living under bad conditions as regards the removal of filth, would engender enteric fever among them, they would be even more careful to prevent the possibility of its appearance, than if they were told that it would certainly spread if brought to them while living under such conditions, but this is not so, and for the simple reason that the people know well enough that enteric fever does not arise under these conditions: they may be deceived about the general death-rate, but they know perfectly well that a field may have the richest possible soil, may be well-manured and well-watered, but that no wheat will grow in it unless the seed is sown, that a place may be in the most unsanitary condition conceivable for many years, and that enteric fever will not spring up in it; and when they are told that it will, they do not recognize this as a fallacy, but jump to the conclusion that the whole of Sanitary Science is a philosophical fancy not worthy the attention of practical people.

But there is still a great fallacy abroad in connection with the question of the removal of refuse matters from the vicinity of habitations. People talk and write as if the water-carriage system and the conservancy systems stood upon the same footing—the principal of the one being the *immediate* removal of excretal matters from houses, and that of all the others being, as their name indicates, the keeping of such matters in and about the house for a certain time. The one is a correct principle, the other is a false one, and it is no argument at all to say that where the water-carriage system is badly carried out, the result may be worse than where the conservancy system is carefully managed. In Sanitary matters, as well as in everything else, we should follow correct principles. If we do not, but by arguments equally specious and fallacious try to persuade ourselves that "practically speaking" (according to the cant phraseology of the day) better results may be obtained by following false principles, nothing is more certain than that by an inexorable law of nature true principles will assert their position, and we shall be punished for our mistake by being landed in difficulties greater than we had to contend with at the outset. It is a very old and often-exposed fallacy to argue against the use of a thing from the abuse of it, and to argue against the water-carriage system because when surface drains have been called upon to do the duty of sewers, for which they were not intended, and of which they are not capable, or because the sewage has been turned into the water-courses, which have thus become unfit to supply water for domestic purposes, is an excellent example

of this kind of fallacy. I do not say that a well-managed conservancy system is not better than a badly-managed one, nor far better than no system at all, nor do I say that there are not places where the difficulty of carrying out a water-carriage system are not so great as to be almost, if not quite, insurmountable; but I do say that in towns where a water-carriage system is possible, there is no room for choice in the matter. The mischiefs that have been traced to the water-carriage system have occurred from the abuse of it, and not from the proper use of it. Sewer air, about which so much has been written, is injurious when it is collected in badly ventilated sewers and allowed to escape from them into the houses, but in an impervious sewer with a proper fall, sufficiently flushed and efficiently ventilated, the noxious ingredients of sewer air are scarcely formed at all, and the air of the sewer is hardly appreciably different from that in the street, while its foulness bears no comparison to that of the atmosphere of many inhabited rooms. The proper way to ventilate sewers is to have a sufficient number of openings leading into them from the surface of the roads, as has been demonstrated over and over again, but I see that the ridiculons practice of having, as far as possible, air-tight sewers, and connecting them with the flues of furnaces, notwithstanding that the fallacy of it was exposed by the Health of Towns Commissioners in 1843, and has been pointed out over and over again ever since, still has its advocates. The Commissioners pointed out that in the first place the action of the furnaces was at times so strong as to draw all the water out of the traps on the house drains, and at other times so ineffectual that the air from the sewers was drawn into the houses through the unsealed traps. They pointed out too that in a case where some of the sewers in Battersea had been connected with the furnace of some soap works, on one occasion coal-gas escaped from a main into the sewer (as has frequently happened since, and not so long ago in the neighbourhood of Great George Street, Westminster), and an explosion occurred which blew the works to pieces.

Another important matter in which we are liable to be led astray by false principles, is that of the supply of water for domestic purposes. A man deservedly eminent in his own branch of medicine, told the public not so long ago from a position that lent weight to his words, that Water-Analysts and Medical Officers of Health had all gone wrong about water: that the small quantities of organic matter that were discovered in water were matters of no

importance at all, that all water, however pure it was, was contaminated with organic matter as soon as it got into our mouths; that the greater part of our food consisted of organic matter, and that it was ridiculous to condemn a drinking water because it contained small quantities of organic matters. The obvious fallacy of such arguments must be patent to all who have thought upon the subject at all, but to the multitudes who allow others to think for them, such fallacies coming from the mouth of one whose words were entitled to be listened to with respect, were calculated to do a vast amount of mischief. There are organic matters *and* organic matters, and it is not because beef and mutton are good for food that putrefying filth, in however small a quantity, coming from sources likely to be tainted with the poisons of specific diseases, is to be tolerated in water for domestic use: and this leads me to speak of a still greater fallacy in connection with the water supply. We are told that it is not necessary to go to the purest sources for water; we are told that we may take a water that has been once polluted, filter it, and give it to the people to drink, that it is a "practically wholesome" water, that no harm can be shown to have resulted from it, and so forth; and we are given averages of its composition to prove that it is "reasonably pure" to be used: but it is not averages we want—we want to know the quality of the worst samples that are supplied. It is ridiculous to tell a man that the average quality of the water given him to drink is good, if on one day in the year he gets water that is "quite unfit for dietetic purposes." But the people are awakening to this matter. They will not be put off by such specious arguments and fallacious reasonings, but they will insist on the "practical" carrying into effect of the true principle as laid down by Mr. John Simon:—"It ought to be an absolute condition for a public water supply that it should be uncontaminated by drainage."

The fallacies connected with dietetics are very numerous, but as they are associated almost entirely with personal hygiene I shall leave the discussion of them for another place. I must mention, however, the curious fallacy about the nutritive power of gelatine, which owes its origin to the results of some incomplete experiments, and which completely upset for a considerable time the belief of scientific men, and of the public generally, although this was not only correct but backed by the experience of ages, that gelatine was an important article of diet. What really is the place of gelatine among foods I will not discuss now. It is sufficient for me to say that more complete experiments have shown beyond doubt

that the ancient experience was reliable, and it is to be hoped that the nonsense about invalids being starved upon jellies and port wine will disappear from our treatises.

The mention of port wine leads me to say a word about alcoholic liquors, but while the opinions of those who are best qualified to judge upon this matter are so divergent, while some of the greatest lights of the medical profession hold that all alcoholic liquors are baneful under all circumstances, and others hold that in moderation no ill effects can be shown to result from them, or even go so far as to say that under the circumstances under which we live, especially in large towns, they may be advantageous not only in disease but in health, it would ill become me to dogmatize upon the matter. There are those—and I think there always will be—who cannot believe that the exquisite *bouquet* of the wines of France, of Italy, and of Spain is only fit to be smelt, there may even be those who are wicked enough to insinuate that if people do not taste them they show a lamentable deficiency in the cultivation of an important sense. While upon this point let me read to you a few lines from the celebrated book on Dietetics that I have already mentioned—"The Regimen Sanitatis Salerni"—the book which has served as a pattern for all books on Dietetics for the last six centuries:—

"The better that the Wines in goodness be,
The better humours they beget in thee.
If Wine looke blacke, it makes thy body dull,
If it be cleare, old, subtile, ripe and full,
Well qualified, leaping, drunke discreetly:
Then with thy body it agrees most sweetly."

All, I know well, will not agree with this, nor with the following:—

"He that drinkes water when hee feede on meate,
Doth divers harmes unto himselfe beget.
It cooles the stomache with a crude infesting,
And voides the meate againe, without digesting."

But all will, I am sure, without exception, agree to the last quotation that I shall make from this remarkable book:—

"Of whatso'ere yee drinke, see no offence
Unto the stomache bee procured thence."

But let it not be thought that I underrate the mischief to be traced to the use of alcoholic liquors. There are serious facts about which there is no fallacy at all. When we find one of our most eminent judges saying—"There is scarcely a crime before me that is not directly or indirectly caused by strong drink:" another

—"I have no hesitation in stating that intemperance is directly or indirectly the cause of by far the largest proportion of the crimes that have come under my observation:" yet another—"If the enormities that have been committed in the last 20 years were divided into five parts, four of them would have been the issues and product of drinking at tavern or alehouse meetings," we have no right to hesitate, and indeed there can be no question in my mind that the drinking of alcoholic liquors does far more mischief than any other habit whatever. One fallacy in connection with this subject is worth pointing out. The man who drinks his glass of grog at night often defends himself upon the plea that the spirit is diluted, and that the mixture does not contain more alcohol than the few glasses of wine usually taken at meals; but the spirit and water thus taken is taken under circumstances which render it most potent for mischief; a highly diffusible liquid, it is taken into the stomach when digestion is over, and when the stomach is nearly or quite empty; it is absorbed directly, unaccompanied by any nutritious substances, into the blood, and is enabled to act in the most prejudicial manner, not only upon the liver, producing the gin-drinker's liver, which means death, but also degeneration of all the tissues of the body.

With regard to tobacco there is a curious fallacy abroad: although the excessive use of it, as of tea or of coffee, or of any substance that acts directly upon the nervous system, is injurious in various ways, there is no evidence that the moderate use of it is pernicious. Sir John Sinclair, who took pains to investigate this subject carefully, comes to the following conclusion in his admirable "Code of Health:"—"It does not appear that a temperate use of tobacco can be considered as an obstacle to longevity." On the contrary, the evidence is very distinct that among the old persons available for the investigations, the great majority were smokers, so it might indeed be argued with some show of reason that smoking was favourable to longevity. For instance, out of 40 persons above 80 years of age, and living in some of the Western Islands of Scotland, "no less a number than 30 (or three-fourths) are reported to have been addicted to the use of tobacco, and of the remaining 10 it is probable that some of them followed the same practice, though it was not adverted to at the time." He states that in Greenwich Hospital there were 96 men exceeding 80 years of age, of whom 13 were above 90 and one above 100—"and yet they almost all used tobacco." He mentions also that of the pensioners in a hospital in Ireland there were "31 above 80 years of age, all of whom, with

the exception of one, were in the habit of using tobacco, and many of them freely." If I am told that these old men might have lived to a greater age if they had not been smokers, I would rejoin, that they, at any rate, lived longer than the non-smokers, and that the argument reminds me of that used by the old lady who said of an inveterate smoker, 80 years of age, "Ah! but if he hadn't been a smoker he might have been 90 by this time!" The arguments derived from the composition of the tobacco leaf and its smoke are obviously fallacious, and cannot stand for a moment in comparison with the facts ascertained by Sir John Sinclair. I must, however, express my agreement with Dr. Parkes that smoking is an injurious and most undesirable habit for growing lads.

Let me pass now to a subject about which we are all much more likely to be agreed. I refer to the fallacies abroad in connection with smallpox and vaccination, and I must take especial notice of the style of fallacious argument employed by those who try to persuade the people that vaccination is not a preventive of smallpox. It is a style of argument well known of old, and very powerful of mischief. Take the following as an example:—"The decrease in the mortality from smallpox towards the latter part of the last century would have continued if vaccination had not been introduced, and would have been more marked than it has been." Here is a style of argument well calculated to throw even wary people off their guard. The false statement upon which the fallacy rests is not put forward as a statement of fact, but is assumed as something well known, and not to be disputed:—"The decrease in the mortality from smallpox towards the latter end of the last century!" This is the way in which it is put, and nine persons out of ten at the very least would not suspect that the statement assumed to be true is the falsest of falsehoods. As a matter of fact, the five most severe epidemics of the last century, each causing a mortality of more than 100 deaths from smallpox out of every 1000 deaths from all causes, occurred in the latter half of the century, and the most severe epidemic of the century, which caused no less than 184 deaths out of every 1000 from all causes, occurred in the year 1796! Take another argument of a similar stamp. "In Prussia everybody was vaccinated and re-vaccinated, yet Berlin was subject to severe smallpox epidemics like other places, and when smallpox was epidemic there lately the number of deaths in one week was three times as great as in London during the height of the epidemic here." This statement was made in 1871 in the House of Commons, and at the request of my friend, Mr. George

Ferguson of Cheltenham, who was then carrying on a controversy in a public paper with the chairman of the Anti-Vaccination League, I took pains to investigate the matter. I then found that up to March, 1874, there had been no compulsory vaccination laws at all for the civil population in Prussia, the law only *recommending* (!) vaccination ; but that in March, 1874, the German Government was so impressed by the severity of the epidemics of smallpox in Prussia compared with those in parts of the German Empire where vaccination was compulsory, that a law was passed making the vaccination of infants and the re-vaccination of children of riper years compulsory throughout the whole of the German Empire. The Swedish statistics, which have always been pointed to as strongly in favour of vaccination, have been recently manipulated with view of proving the reverse. I have before me the statistics for 124 years. In the 61 years before the practice of vaccination, there was only one year in which the deaths in Sweden from smallpox were less than a thousand, and there were 9 years in which the deaths were over 10,000. In the 63 years during which vaccination was practised, there were 48 years in which the deaths from smallpox were under a thousand, and in no year did they reach 10,000 or even 3000.

There is another class of diseases, the prevention of which is to a certain extent dealt with by Acts of Parliament, and about these too it seems to me that a serious fallacy is widespread. Whatever many well-minded people may say to the contrary, I must, speaking not only from a sanitary but from a humanitarian point of view, maintain that it is not our prerogative to visit the sins of the fathers upon the children ; and in answer to the common argument brought against attempts to prevent the spread of these diseases, I would re-echo the words of Dr. Farr:—"Morality, it may be hoped, will be inculcated by higher agencies than enthetic diseases."

Although I do not mean to enter into a statistical discussion, I will mention one or two serious statistical fallacies that are very prevalent, and out of which much capital is made. We are told that in spite of sanitary improvements the death-rate remains the same ; now, considering that "the mortality of the City of London was at the rate of 80 per 1000 in the latter half of the 17th century, and 50 in the 18th, against 24 in the present day" (Farr), this statement seems rather audacious. We are also told that the death-rate of London is and has been for some time practically stationary, but since the density of the population is increasing, the death-rate

ought to be increasing, whereas it is actually diminishing. Dr. Farr shows that the death-rate of London (calculating from its density), ought to be 35·2 per 1000 per annum, whereas it is now under 23. Again, we are told that the death-rate from zymotic diseases is stationary; but surely the wonder is that it is not increasing rapidly.

Yet another statistical fallacy:—The death-rate of London is very low indeed; we are positively told that this is due to the influx of healthy lives from the country! whereas, as a matter of fact, they make an almost inappreciable difference in the death-rate. The annual influx of immigrants forms in time a permanent addition to the population, but as their death-rate (say that of persons over twenty years of age), differs but little from that of the community at large, or from that of persons under twenty years of age, they scarcely affect the general death-rate themselves at all; if we are required to debit London with the deaths of persons under twenty years of age, of whom the immigrants may be said to be the survivors, we must also credit the population of London with the additional population, under twenty years of age, which would result from an annual number of births equal to that of the immigrants, and of the persons under twenty whose deaths we have taken into account. Thus it can be easily shown that the death-rate is hardly affected at all by immigration.

Lastly, I would refer to one great fallacy of a totally different kind, that I see is likely to become dangerous. A house divided against itself cannot stand, and I look upon the existing jealousy between various sanitary organizations, I will not say with the greatest alarm, but with serious apprehensions. If we wish to make the public believe that we are in earnest about sanitary reforms we must be united among ourselves, and not go about wringing our hands, as some do, because others than themselves have a share in the good work.

W. H. Corfield, m.a., m.d. (Oxon) f.r.c.p. (Lond.)

SUPPLEMENTARY SECTION.

SUPPLEMENTARY SECTION.

A supplementary meeting was held on Saturday, October the 25th, in the Small Public Hall, George Street.

Dr. B. W. RICHARDSON, F.R.S., President of the Congress, in the chair.

Dr. BALBIRNIE gave an account of his plans for constructing and ventilating barracks, hospitals, board schools, &c.

[For epitome of Dr. BALBIRNIE'S paper, and discussion, see Engineering Section, pp. 166, 7].

The CHAIRMAN next called upon Mr. J. E. ELLISON for his paper on "Ventilation of Buildings."

[For abstract of paper, and discussion, see Engineering Section, pp. 163—6].

Mr. WALLER followed by explaining the method he has adopted in ventilating buildings at Herne Bay. This consists in narrowing the chimney flue about six feet from the floor line, to prevent back draught; making an outlet in the chimney breast for the foul air of the room; providing a five-inch vent or bead to the windows, so as to allow of the upper sash being drawn down without exposing any opening at the top, whilst air enters between the sashes.

The PRESIDENT then asked Mr. SOPER to read his paper on the

Disinfection of Excreta.

WHEN I had the honour of addressing you last year at Stafford I fear my explanations were but crude and superficial, and a year's experience leads me with bolder hands to bring my invention to your notice. I will, I promise, not weary you with more than a slight sketch. Here, then, is an apparatus made of incorrodible material, the object of which is that from certain ingredients, viz., manganese, salt, sulphuric acid, and water in definite proportions, a stream of chlorine gas is continuously evolved for three to seven days without any further attention whatsoever.

I am of opinion that of all known disinfectants chlorine gas is absolutely without a rival, and not forgetting the important part played by it as a decomposing agent by its great affinity for hydrogen, and on the score of cheapness, I know of no rival. In my apparatus it can also be evolved instantaneously, as in the form of euchlorine, when hydrochloric acid is added to chlorate of potash.

Both gases decompose sulphuretted hydrogen and sulphide of ammonium, of which most fœtid effluvia mainly consist—the effluvium of sewage especially. I employ disinfectors of every size, according to the purposes for which they are required; those of from half-a-pint to a pint are the most useful sizes. If an ambulance is to be disinfected, I would use a small size, and generate euchlorine; but for a gully hole or ventilating shaft from a sewer, I would use a gallon size. If the apparatus is suspended over a collection of manure it is curious to watch the dense gas meeting the light ammonia, and forming a visible cloud of chloride of ammonium, and with entire destruction of effluvia. I have for a lengthened time employed my apparatus in sick rooms and infectious hospitals with immense relief to the inmates, and destruction of all bad odours, without in any case a complaint of undue potency, for bear in mind my principal scheme is that chlorine shall be produced in the slowest possible form, without intruding its presence. Most of you are aware of the horrible emanations in cases of phagedæna, gangrene, &c., and with all our care the case becomes revolting in every sense to all who come in contact. I have recently had constructed a cradle covered with india-rubber; at one end is an elastic diaphragm through which a gangrenous leg may be placed. At the opposite end is a valvular opening, through which is suspended a small disinfector. Let me read you the result, and you will draw your own conclusions as to its benefit in the general ward of a hospital. A case under the care of Dr. Hammerton, in Lambeth Infirmary, of a woman, aged seventy-two, suffering with gangrene of all the toes, said to be result of frost-bite. Charcoal poultices, with carbolic acid, and chloride of lime around the bed, were ordered. A distinct line of demarcation was formed, and the gangrenous parts removed; but the disease returned, and was as offensive as ever. A generator was then used in the way I have described, and no dressing whatever was applied to the leg. Result most satisfactory; offensiveness entirely removed, discharges healthy, sloughs separated, leaving a healing surface, and in three weeks the foot was well. He says he has adopted the same arrangement in sloughing phagedæna, and with equally gratifying results. I do not mean to advise absolutely that the gas shall be wholly confined, but a certain portion will naturally escape from the end of the bed. The atmosphere of a *post mortem* room or mortuary is often peculiarly sickening: here are cases for its use. Again in typhus, if a small disinfector is placed high up above the patient's head. I believe the danger of infection to others is minimized. In the *British Medical Journal* I notice these words—"The explanation of the mortality amongst medical men and nurses is to be found in the fact that the poison of the disease is contained in the cutaneous and pulmonary exhalations of the sick, that it is conveyed through the air by fomites, that it is then inhaled, or perhaps swallowed with the saliva, and so finds admission into the blood of the healthy.

Every physician who has had any experience of typhus must be familiar with the strong ammoniacal odour of the breath, and still

more with that which escapes on turning down the bed-clothes. It has been found that those patients are most apt to communicate the disease in whom the odour is strongest. Now, this being an accepted fact, how can we doubt the efficacy of chlorine. If disinfectants are to be of service they must be continuously in the air, and disease then meets with its natural antidote, a diluted atmosphere of chlorine. I think Dr. Raikes' statement substantiates this, "that the floating organic vapours or molecules of whatever kind in the air are destroyed by the air purifiers, as shown by their influence on odours." Daily I am told by those who have never used any apparatus that an atmosphere in which chlorine reigns is absolutely prejudicial and dangerous. This I positively assert is not the case when employed as I suggest. I received a letter from the medical officer of a mail steamer, in which he says they had sickness on board, and from bad weather had to close ports and hatches, and during this time a disinfector was working with the happiest results to the inmates of the cabin. I know I am treading on dangerous ground if I read you a review of Dr. Notter's work, in the *Lancet* of Oct. 11th, for the number of disinfectants are legion, and they each have their special claims, and are mostly recognized preparations. He experimented most fully with Carbolic acid, solid and liquid, Chloride of Lime, Condy, Terebene, Sanitas, McDougal, Phenyl, Burnett, Eureka, Sporokton. A small quantity of Beef infusion was used in all the cases, which, after keeping, was loaded with bacteria, and a certain definite proportion of each disinfectant was used.

Carbolic.—Bacteria still living, but sluggish.

Condy. – Vibrio, spirillum and other bacteria in active motion.

Terebene.—Bacteria still very active.

McDougal.—Bacteria equally distributed, but activity diminished.

Barnett.—Activity of Bacteria very much diminished.

Chloride of Lime.—Bacteria nearly all precipitated in filmy clouds of disinfectant, and no movement visible.

Further modified experiments were made, but chlorine surpassed them all. I have little more to add, but to say that in the drain disinfector it is placed near the outlet of the hospital, and that it actually slips into the sewage; a stream of chlorine is continuously evolved, and the whole of the upper level of the drain pipe is filled with the gas, and as each portion of water passes the nozzle so does the water carry away with it its disinfective property, and if a defective trap exists, which too often is the case, no regurgitation of sewer gas can occur in its vitiated form. This latter apparatus being of a large form does not require changing more than once a week. This I have arranged by making it conical, so that as the acid becomes weaker so has it a smaller surface of powder to act upon, and in that way a balance is maintained.

For the disinfection of rooms I think my apparatus may be shown to have a great advantage over burning sulphur, the ordinary mode of destroying contagion, the risk of fire being no small consideration. Those who would go further in the matter I would refer to the remarks of Dr. Richardson in his "Diseases of Modern

Life," who goes fully into the danger of impure air and all its attributes.

I am informed that the principal ingredient, binoxide of manganese, may be purchased at 16s. a cwt., and the commercial sulphuric acid at about 1¼d. a pound. The salt can hardly be computed. I have made experiments on a very large scale in connection with the metropolitan drainage, with the happiest results.

William Soper, M.R.C.S.L., L.S.A.

The author showed a number of pieces of apparatus, both complete and in section, in explanation of his plan of disinfecting the excreta from hospitals, &c., and also performed a few illustrative experiments.

The President stated that Mr. Soper's apparatus had been employed for some time in his own laboratory for deodorising purposes, and complimented him on his efficiency. He also called attention to his own evidence before the Lords' Commission on Noxious Vapours.

Dr. F. de Chaumont pointed out that the question of Disinfection was one on which much misapprehension existed. Nearly all disinfectants so-called were little more than deodorants. He referred to his own experiments, which proved that even the deodorising power was not always so great as believed, and to Dr. Notter's experiments which showed that to effectually destroy the lower organisms much more powerful doses of reagents were necessary than could in practice be applied. The only true disinfectant was heat, which was of course applicable only to certain cases. The power of chlorine was admittedly great in decomposing animal substances, and destroying dangerous products, and when it could be employed in sufficient quantity it would likely be efficacious. Thus in the case of a typhoid patient the immediate addition of a strong dose of chloride of lime stools would probably render them innocuous, even if passed into the drains. This plan was adopted at Netley, where typhoid stools were immediately disinfected in this way and poured into the sea. The result was, that although numerous typhoid cases had been admitted (from board ship, for instance), no case had yet originated in the building itself. Mr. Soper's apparatus was a very ingenious one in arrangement, but the doubt that suggested itself was, whether it was really useful, having regard to the quantity of chlorine that could be liberated in comparison with the bulk of sewage to be treated. With properly-constructed and properly-ventilated sewers disinfection ought not to be required.

Dr. Ball read a paper "On an Improved Mode of Influx and Efflux Ventilation."

The paper was illustrated with a number of diagrams and experiments, and with models of the apparatus described.

The President, in the absence of Mr. F. H. Porter, read the last paper on the list.

The Softening and Purification of Water by the process of the late Professor Clark; with a notice of a system by which it is rendered more generally available.

Although nearly forty years have elapsed since Dr. Clark brought to the notice of the world, by letters patent, his valuable process for "rendering certain waters less impure and less hard for the supply of manufactories, villages, towns and cities,"—and although a few very fine examples of its application to the water supply of towns have been in existence for some years—this process is but very little known and very imperfectly understood.

To something the author of this paper has sought to do—and not without some success—in rendering the process of Dr. Clark more generally available, he attributes the invitation he has been honoured with to read a paper upon this occasion.

In the *Journal of the Society of Arts* of 1852 may be read a very lucid description of his process by Dr. Clark himself; and, embalmed in Blue-Books, the reports of three several Royal Commissions upon the quality of the water of the River Thames, upon the water supply of the metropolis, and upon the domestic water supply of Great Britain, teem with evidence of the value of this simple and beautiful process.

Professor Frankland, a member of the Royal Commission of 1868, gives in his work, entitled "Experimental Researches in Pure, Applied, and Physical Chemistry," a *resumé* of the valuable report of that Commission in relation to Clark's process of softening water by the use of lime. This report contains some account of the waterworks of the Chiltern Hills Spring Water Company near Tring, of the Caterham Spring Water Company, of the Canterbury Water Company, and those of the Colne Valley Water Company near Bushey Station on the London and North Western Railway.

The last-named were designed by Mr. J. F. Bateman, F.R.S., now President of the Institution of Civil Engineers; and the others by Mr. S. C. Homersham, C.E., who has done more than any one else to give practical effect to Mr. Clark's discovery.

One of the works just named—viz., those of Caterham, is within a walk of Croydon; and another example by Messrs. Quick and Son, Civil Engineers, is at Kenley, still nearer to this place. Shall I be though impertinent if I inquire, why Croydon has not followed the good example at her doors?

It may be that Croydon, generally, is hardly aware of the existence of these works, and of their *raison d'ètre.*

It may be that latterly it has been halting between two opinions: a novel mode of dealing with Clark's process, more recently in

operation on Banstead Downs—within another walk of this place—may have induced them to hesitate.

Of water less hard than that of Croydon—viz., the water of the Thames, the General Board of Health (of which your Vice-President, Mr. Edwin Chadwick, C.B., was a member), in May, 1850, reported—

"That its inferiority as a supply for domestic uses arises chiefly from an excess of hardness, rendering the water especially unfit for the following uses—viz., for cleaning the skin and for the ordinary purposes of washing, by occasioning an excessive consumption of soap; for the preparation of tea, by occasioning waste to the like extent: and for all culinary processes by diminishing their efficiency and increasing their expense."

They add, that the saving in soap from the use of soft water in the operation of washing would be probably equivalent to the whole of the money expended at present in the water supply—for, estimated at an average of 1*s* per head per week, the expense of washing linen and other clothes of the then population of the metropolis amounted to nearly £5,000,000 per annum.

They estimated the saving in tea from the use of soft water at about one-third of the tea consumed in the metropolis.

"That soft water would prevent those incrustations and deposits in boilers and pipes which render hard water unsuitable for manufacturing purposes."

"We therefore advise the rejection of all schemes . . . . which adopt, as sources of supply, the Thames and its tributaries of the same degree of hardness, *wells*, and *springs from the chalk* or other formations which impart the quality of hardness."

That was in 1850. In 1851 the Government appointed a Commission—consisting of the late Professor Graham, F.R.S., Master of the Mint; the late D. W. Allen Miller, M.D., F.R.S., Professor of Chemistry at King's College; and Dr. Hofman, F.R.S., Professor of Chemistry at the Royal College of Chemistry—to report upon the water supply of the metropolis.

This Commission, while confirming what was reported by the General Board of Health in relation to the waste and uncleanliness attending the use of hard waters, say of the chalk spring-water "AFTER BEING SOFTENED it is an extremely pure water. It appears to be considerably superior even to the soft water from the streams of the Surrey sands. The chalk-water *alone* is uniform in its excellence at *all times*, the sources of it lying beyond the influence of weather or season. In the judgment of the Commissioners, the SOFTENED chalk-water is entitled from its chemical quality to a preference over all others for the future supply of the metropolis. It is no longer possible to disregard chemical means of removing hardness, or to represent them as impracticable on a great scale; they place the question of water supply *upon an entirely new footing*"—(Sixth Report, p. 208.)

The hardness of these chalk waters (and the Thames is largely supplied with water from the chalk) is due to their containing lime in that combination with carbonic acid termed bi-carbonate of lime.

Dr. Clark's process may be said to consist in throwiug out lime by means of lime; and the Report of the Royal Commission of 1868, says—at page 205:—

"The economy which carbonate of soda exhibits in comparison with soap as a softening agent is far surpassed by that which results from the use of lime for this purpose. The latter material costs only 8*d* per cwt. and this weight of lime will do the work of 20¼ *cwt. of soap* in softening hard water, or of 4⅓ *cwt.* of carbonate of soda."

As the prices at which soap and soda may now be purchased may be less than in 1874, when the Reports was issued, it is sufficient to state the respective quantities equivalent to the cwt. of lime costing 8*d.*

But, as Professor Frankland has recently remarked in an official report upon the metropolitan water supply, the water *must* be softened with something, before the soap can take any useful effect in washing. What that "something" commonly is, our laundresses—our "*blanchisseuses*" (a more expressive word) best know.

The way in which Dr. Clarke makes use of lime for this purpose may best be described in his own words:—

"In water, chalk is almost or altogether insoluble, but it may be rendered soluble by either of two processes of a very opposite kind. When burned in a kiln, chalk loses weight. If dry and pure, only nine ounces will remain out of a pound of sixteen ounces. Those nine ounces will be soluble in water, but they will require not less than forty gallons of water for entire solution. The burnt chalk is called quick-lime, the water holding the quick-lime in solution is called lime-water, and the solution thus made is perfectly clear and colourless.

"The seven ounces lost in burning the pound of chalk consists of carbonic acid gas.

"The other mode of rendering chalk soluble in water is nearly the reverse. To dissolve in the second mode, not only must the pound of chalk *not* lose seven ounces of carbonic acid, but it must combine with seven *additional* ounces of that acid. In such a state of combination chalk exists in the waters of London—dissolved, invisible, and colourless, like salt in water.

"A pound of chalk thus dissolved in 560 gallons of water would form a solution not sensibly different from the filtered water of the Thames in the average state of the river."*

If the forty gallons of clear lime-water be mixed with the 560 gallons of clear water in which a pound of chalk has been dissolved by the addition to it of seven ounces of carbonic acid, a haziness very soon appears; this deepens into whiteness, caused by the nine ounces of quick-lime entering into combination with the seven ounces of carbonic acid by means of which the pound of chalk was dissolved and rendered invisible in the 560 gallons of water—for by this combination of the nine ounces of quick-lime

* And 1 lb. in 400 gallons of spring water.

with those seven ounces of carbonic acid, a pound of insoluble, and so visible, chalk is formed; while the pound of chalk deprived of those seven additional ounces that rendered it soluble and invisible, becomes again visible, insoluble. Thus there are two pounds of chalk reproduced in a solid state by adding the forty gallons of lime-water to the 560 gallons of water containing the solution of bi-carbonate of lime.

But these two pounds of chalk are reproduced in infinitely minute crystals, and it is only after a considerable lapse of time that these subside to the bottom of the vessel, leaving the water beautifully clear above.

A small experiment will perhaps interest many who may never have seen the effect.

Although the waters of different localities differ in the proportion of bi-carbonate of lime they hold in solution, there need be no important difference or variation in the *quality* of the lime-water employed; there being a limit to the amount of quick-lime that water will hold in solution, and that may be taken as nine ounces in forty gallons, as explained by Dr. Clark.

Water dissolves up or absorbs lime but slowly unless it be present in very great excess; therefore at works where the process of Dr. Clark is in practical operation the lime-water tanks or reservoirs contain an enormous excess of lime, and the commotion formed by filling them is increased and maintained for a time by blowing in air by means of an air-pump worked by the steam-engine, or the rousing and mixing of the lime with the water may be performed by rotating arms and frames, worked by gearing, as at Mr. Homersham's smaller works for the Government on Shooter's Hill.

I have adopted this latter plan for the lime-water tanks in two places, and in others the air-pumps; and in others I have relied upon the injection of the water under pressure through perforated pipes laid in the bottom of the tank, as was formerly the method at Caterham; it is not so effective as is desirable, and has to be supplemented by hand labour.

The agitation is maintained for about thirty or forty minutes and then discontinued, and in the course of a few hours the excess of lime falls to the bottom, leaving the clear solution of lime, or "lime-water," with which to operate upon the hard water to be softened.

I am not aware if any ready means of testing the comparative strength of the lime-water is commonly provided; but I believe not. It would appear to be useful to do so; because, by the ordinary way of carrying out the process, it is only when the whole of the day's supply has been treated that it can be determined whether or not a due proportion of lime-water or of lime in solution has been employed.

There is this, however, to be said: that there is little if any risk of any appreciable excess of lime being introduced—certainly no such proportion as is now commonly administered to infants as a preventive of, or corrective to, acidity. Of course an insufficient

dose of the solution of lime would leave the softened water less soft than it might have been.

The mixing of the two waters is carried out in large reservoirs corresponding in capacity to the daily supply required; and as the subsidence of the particles of chalk is not completed under many hours, at least a pair of such reservoirs is needed, and I believe a third is commonly provided, into which the cleared lime-water is lowered from near the surface by the mouth of a pipe sustained by a float.

Now, the amount of space occupied by these reservoirs has practically excluded Dr. Clark's process from establishments in which it might otherwise have been very usefully applied, in economizing fuel very largely, by removal of the non-conducting substance that adheres to the interior surfaces of steam-boilers fed with water containing bi-carbonate of lime.

The woollen manufacturer and dyer, the calico printer and the paper manufacturer, and many others, suffer in the technicalities of their trades from the presence of carbonate of lime in the water they largely employ.

This brings me to the mentioning of a method of treating large quantities of water within a small space, that I have ventured to style the "Porter and Clark" process. In a little *brochure* I prepared for the occasion of the Conference on the National Water Supply, at the house of the Society of Arts in May last—and some copies of which are in the room to-day—will be found more details of it than time will allow me to read.

Now, it is far from a *new* idea, that, seeing within how short a space of time the chemical action of the lime-water upon the solution of bi-carbonate of lime is completed, the chalky product should be separated by filtration, and the process carried on continuously; thus avoiding the occupation of the considerable space, not to speak also of the considerable cost, demanded by and attending the provision of reservoirs, in duplicate, of capacity equal to one day's supply of water.

If the chemical action can be completed within twenty minutes, why not provide a vessel, or a pair of vessels, of a corresponding capacity, rather than a pair of reservoirs each of a capacity equal to twelve hours or more?

Dr. Clark, in his patent, appears to have contemplated filtration, but without hinting by what means, and, although in the interval some patents have been taken out with this object, nothing appears to have been actually done—the difficulty of cleansing the various filtering media proposed from the accumulating deposit of the infinitely minute atoms of chalk, and the cost of renewing them, having probably been deemed insurmountable.

In 1876 my attention was drawn to the subject, and the non-success of an apparatus applied to soften and filter the water of a large manufactory I was acquainted with, led me to consider the adaptation of an apparatus of which many types have been applied to purposes of a different kind.

My experiments were most successful, and were hardly matured when they attracted the notice of the Middlesex magistrates, then considering, under the advice of their Consulting Engineer, Mr. F. J. Bramwell, F.R.S., the question of softening the water of their new asylum on Banstead Downs.

After a demonstration at Banstead, upon a scale of 2000 gallons per hour, Mr. Bramwell advised the adoption of my method for softening and filtering 60,000 gallons per day.

At the same time, Messrs. Giles and Gough, architects of the Kent County Asylum, recommended its adoption there to the extent of 50,000 gallons per day.

My system has been in operation at both places for more than two years: the plant at Banstead being contained within a room twenty-one feet square, and at Chartham within a room of eighteen feet square.

The water at these places is of the same character as the Croydon water, from deep wells in the chalk—their hardness is about seventeen degrees, and this is reduced by the process to three and a half degrees.

A more recent example of my system, embodying some improvements in detail dictated by experience, has been for nine months in operation at the paper mill of Mr. Lloyd at Sittingbourne. This is also chalk spring water. The quantity for which the plant is designed is 120,000 gallons per twenty-four hours, the mill working night and day. This necessitates two lime-water tanks, but the whole plant is contained within a corner of a large warehouse, and occupies an area of twenty-seven and a-half feet by twenty feet.

This quantity of water, treated within twenty-four hours and within the space named, is, as I have been told, the same quantity as treated within twelve hours daily at Caterham Waterworks, which I recently visited. Those works have been, as to subsiding or settling tanks, greatly enlarged, and occupy a space that would be inadmissible in most manufactories; and this brings out the practical difficulty that has operated to preclude the adoption of Dr. Clark's process for the object to which he gives the first place in the title of his patent—viz. "*Manufactories.*"

Taking, again, the 120,000 gallons treated daily at Caterham on a very extensive area, as a standard of comparison, I am now preparing the necessary plant for treating 144,000 gallons by day and 144,000 gallons by night—*i.e.*, 200 gallons of water per minute continuously, within a room thirty feet by forty feet, and this room will be above that which contains the engines which raise the water from a well 500 feet in the chalk. This is at Silvertown, near North Woolwich, for the India-rubber and Telegraph Works Company.

In the same neighbourhood, at the sugar refinery of Mr. Duncan, my system of filtering water, in course of treatment by Dr. Clark's process, has been in operation for more than two years.

All these applications in manufactories have for their object the saving of fuel; and I trust that the confession will not draw upon

me the reproof of this meeting upon the ground of its not being a Sanitary question interest. I should at least claim to be a worthy disciple of Professor Clark and member of this Institute in that I had brought his process into operation to mitigate the poisonous effect of the consumption of large quantities of fuel, upon the atmosphere of towns and cities. This will appear in connection with the economical aspect.

At one of the establishments I have mentioned there are upwards of twenty steam boilers of large dimensions, consuming more than four hundred tons of coal weekly. It has been necessary to keep a set of men continuously occupied in removing the incrustation of lime, derived from the chalk water, at a cost in wages of £10 per week, while the use of two boilers undergoing the operation is meanwhile lost. Working night and day—it is only at long intervals that a refitting or overhauling of the machinery and boilers can be thoroughly done: when that occurs, and all the boilers are started freshly freed from scale or "fur"—it is found that about sixty tons less of coal are consumed than during the week when they were last at work. Thus, the SANITARY and *economic* interests combine.

Dr. Clark's process has been, save for a temporary experiment many years ago, confined to the treatment of waters free from organic matter and from alumina or earthy matter in suspension. In short, it is nowhere applied to river or open reservoir or pond water, for it has been found that a proportion of the chalk sufficient to produce a dulness in the appearance of the water remains a long time in suspension in combination with those other matters. Subsequent filtration would be necessary, or a very extended system of "subsidence" reservoirs.

The Swindon Water Company were much troubled by the dulness of the water they collect in their reservoir from the surface springs with more or less—according to the rainfall and snow—of surface water from a wooded ravine above, which gives also contributions of vegetable and earthy matters. They had no filtering beds, and the contracted space and the situation made them difficult of application.

Having visited the Canterbury Waterworks in order to see Dr. Clark's process, the directors subsequently visited the Banstead Asylum and Mr. Duncan's works, and inspected my system of filtration of water under treatment by Dr. Clark's process. They saw that, by my method, the fine precipitate of crystals of chalk alone served as the medium of filtration upon cloths of cotton twill placed like a succession of towels upon "towel-horses" and separated by chambers and compartments of about an inch in thickness, each compartment in the series, fed by a common channel, being a complete filter in itself—and giving off its separate quota of filtered soft water to an outlet common to all.

They recognized at once that this beautifully pure filtering medium arresting such infinitely minute atoms as those produced by the lime-water process, would certainly arrest therewith

whatever of vegetable or earthy matter might be present in their reservoir water.

They determined upon adopting my process.

The work has been excellently carried out by the Great Western Railway Company's establishment, and the mixing tank and filters for treating 20,000 gallons an hour, or 250,000 gallons per day, are contained within a building sixty-one feet in length by eighteen feet in width and thirteen feet high in the walls; the pair of lime-water tanks of plate iron thirty feet by fifteen feet, and eight feet in depth are placed upon the higher ground outside; the whole being upon the slope of a hill and supplied by gravitation of the water from the reservoir above.

Some details will be found in the little printed description of the Porter-Clark process in the room.

Nothing can be more beautiful than the softened and filtered water at Swindon; but it must be said that it has occasioned more trouble in changing the cloths of the filters than the water of the chalk wells—as indeed was to be expected; and long neglect of cleansing a reservoir situated as is that at Swindon would bring upon the company a corresponding difficulty with their filtration.

A difficulty of that kind manifested itself at the outset and was remedied, and for some time the Swindon filters gave less occupation to the one man and a youth in charge of them than the filters at Banstead to one man in charge there. Later, we have had great quantities of rain, over a long period, and Professor Frankland, in his official report of February last upon the metropolitan water supply, says:—"Owing to the frequent and heavy floods the river waters were often much polluted and difficult to filter, whilst the deep well waters maintained their usual brilliancy and purity." It is not claimed for the Porter-Clark process that it is exempt, when applied to river or to impounded waters, from those difficulties of filtration Dr. Frankland mentions as attending the ordinary systems. What is claimed for it is a degree of excellence in the clearness of the water treated by it hitherto unknown in any method of filtration conducted upon a large scale, together with an extraordinary economy in space, and an absolute security for the daily removal of the impurities arrested by the chemically pure crystals of chalk forming the filtering medium.

This is a feature of first importance. I noticed that in the discussion of health questions at the Social Science Congress, recently held at Manchester, Captain Douglas Galton remarked upon the evil that might be expected to result from filtering water through a continuously increasing deposit of impurities, as is the case with most house filters, and to some extent with the filter beds of the water companies supplying London with water. By my system, it becomes a question of wages certainly, but the filtration of water through its accumulating and decomposing impurity is out of question; the cloths, with their adherent deposit of carbonate of lime and impurities, are necessarily removed daily. If my softening and filtering house on a large scale has somewhat the

aspect of a manufactory, it may be said to be manufacturing purified water, soft and clear, at the cost of perhaps one-third of a penny per thousand gallons, when organized upon a large scale.

In saying this, I am not claiming that Dr. Clark's process, when supplemented by my own, will eliminate much of impurity in chemical solution.

Something in that way it may be expected to accomplish, aided as the lime process is by the constant agitation—ebullition, so to speak—of the water in the mixing tank produced by the pumping in of air to promote the chemical reaction.

In conclusion, I would say that, while hitherto speaking of large quantities of water, small quantities can be considerably softened and filtered by my method.

T. H. PORTER.

AN ADDRESS

ON THE NORMA OF SANITATION IN THE SCHOOL STAGES OF LIFE.

AN ADDRESS

ON THE

Norma of Sanitation in the School Stages of Life.

Mr. Edwin Chadwick delivered the following Address at the Anerley Schools :—

At our last International Sanitary Congress, held at Brussels, it was agreed that the best immediate direction of the efforts of Sanitarians will be for the reduction of infantile mortality ;—because the evils of unsanitary conditions are the most severe with children; because with them those evils are to a very great extent removable by administration ;—because those evils may be the most readily acted upon, in the school stages of infantine life ; and because the strongest popular sympathy may be evoked to aid our efforts—for men and women of the lowest class, when they understand the matter, will aid in doing for children what they are heedless in doing for themselves. We have to deal with conditions in populous districts, in which half of all who are born are dead within five years. In London, which, by those who have yet to be largely instructed as to Sanitary power and principle, is boasted of as the healthiest city in the world, there are districts in which about half of all born of the lower class are in their graves by their sixth year. On an examination, a few years since, it appeared that the excess of deaths in the school stages of life throughout England and Wales amounted to upwards of fifty thousand annually. Now we have to deal specially with the causes of such deadly excess. Epidemics in the school stages of life, generally occur when children with filthy skins and filthy clothes are massed together and kept together in sedentary constraint during long hours. This institution supplies a normal example, happily not the only one, of the results generally obtainable by the removal of these conditions. This may be elucidated by reference to past conditions, and to the progressive application of principles with the elaboration of which I have had much to do.

Immediately after the formation of the first Poor-Law Board, there fell to our direct control three large establishments for the maintenance of children by contractors for parishes too small to keep up, without disproportionate expense, establishments of their own. In two of them we were confronted with the task of dealing with frightful epidemics. There were as many as one-third of the children down with fever at one time, and a dreadful mortality, both of which properly excited public attention. One of the establishments (Mr. Aubin's, at Norwood) might be said to be, from the benefits derived from its subsequent treatment, the predecessor of such separate establishments as the present. Mr. Aubin at once frankly offered to carry out implicitly all the instructions he received; and he eventually derived great benefit from his practice in doing so. The general opinion of scientists—of curative science—was that the children must have been insufficiently fed, and an augmented dietary was the sole preventive which was recommended to us from that source, and such recommendation was in accordance with popular opinion. We sent Dr. Neill Arnott, who had some perceptions of rudimentary Sanitary Science, and he reported that the great cause was foul air from the conditions in which the children were massed together; and an improved ventilation was the main remedy he prescribed, which was adopted. Then there followed the improved air-cleanliness by drainage and ventilation, skin-cleanliness by head to foot ablutions, not with cold but with tepid water; and, further, by clothes-cleanliness. As to clothes-cleanliness, Mr. Aubin being questioned as to whether clean pinafores every day for the girls was not a luxury, answered that in a family a soiled pinafore or two might not be of any moment, but that several hundred soiled pinafores brought together made an appreciable difference in the purity of the atmosphere, which was to be taken into account. Ophthalmia, which is rife in the low neighbourhoods, was the most difficult disease to keep out and eradicate, but this at last is accomplished by extreme vigilance and cleanliness on admission.

I must here claim credit for the introduction of the half-school time principle, which I got introduced into the Factory Acts, by which all the evils common to the long-time schools are reduced in the same ratio, which is one-half. The prominent evils in those schools are enervation, by the reduction of the natural amount of bodily exercise, and inaptitude for manual labour; distorted spines with girls, injured eyes and near-sightedness, and aggravation of congenital weaknesses in both sexes. These are the common evils of

long-time detention in the common schools, and though they would be largely reduced by the several Sanitary factors—air-cleanliness, ventilation, skin-cleanliness and clothes-cleanliness, yet if even clean children were a long time massed together in the open air, they would still be subjected to some aerial impurity from their own atmosphere, and to the evils of excessive bodily constraint. The saving of time from excessive sedentary desk-work facilitated the introduction of physical exercises, of which the military drill and naval exercises were the most convenient. These introductions have been supplemented and relieved by various exercises for boys, by swimming, by manual industrial occupations; and appropriate exercises have been provided, with agreeable variations, for girls and also for infants:—such as are the conditions of healthful education which it is the chief object of this visit to display to the members of the Congress. One arrangement to be observed, in passing over the building, is that a separate bed is provided for each child, instead of putting two in a bed as is the common practice. Important Sanitary results have been obtained by this arrangement. The results of the progressive application of the Sanitary factors—air-cleanliness, skin-cleanliness, varied sedentary constraint, increased and improved bodily exercises, of a varied improved dormitory accommodation and improved dietaries—have been gradual reductions of the sickness and death-rates. These were a few years ago reduced to about one-half the sickness and death-rates prevalent amongst the children of the school-ages, but of every class and degree, included in the Registrar-General's returns: that is to say, the improvement was gained with children of the lowest type, a large proportion of whom are brought in with congenital defects and disease upon them. In this institution—taking the mean of the first five years, since 1871, and of the last five years—the mean death-rate for the first five years was 5.8 only; and the mean of the last five years, the years which include, with other improvements, greater care in probationary wards, the mean death-rate has only been 3.4 per 1000, little more than three per 1000! To give an idea of the point attained in this norma of sanitation, I may mention that a gentleman who had visited a number of boarded-out children stated what he considered to be a most conclusive and satisfactory fact, that the death-rate amongst them very little exceeded 2 per cent.; that is to say, did not exceed twenty per 1000, for what must be presumed to be to some extent selected children lodged in selected cottages! The mean of the cases of sickness in the infirmary of the institution, for the

first five years, was 180 per 1000; and for the last five years only 43·8 per 1000, or little more than 4 per cent., which includes very slight cases indeed, such as would pass with little regard in the common schools. I have had normal instances of Sanitation in institutions for children of a superior type where even better results than these have been obtained.

These great Sanitary results, affirmed in other and varied instances, are not of the distant future and the hypothetical, but of the immediate and realized; while their practical application may be generally extended in ways to be shown hereafter, for the prevention of the greater part of the diseases which afflict and destroy life in childhood.

I can only advert shortly to one great topic, of the moral progress which accompanies correct Sanitary and physical progress. It has yet to be understood how much of disorder, of rebellion, of moral depravity, and of crime has its root in physical disorder and depravity. The fever nests and seats of physical depravity from which the regenerated children of the Institution mostly come, are also the seats of moral depravity, disorder, and crime with which the police have the most to do. An example of the disorder arising from physical causes in the common training of children, may be presented from a temporary interruption of progress in this Institution. From such ignorance of principle as is common amongst those bodies to whom the working of scientific factors is confided, without aid or correction—a former managing committee agreed that the military drill—the chief available mode of physical training — was unnecessary, and they dismissed the drill-master. The immediate result of the deficiency of bodily exercise was bodily irritability, and thence uncontrollable mental irritability on the part of the boys;—there were tumults and bolstering in the dormitories, breaking of windows, of chamber utensils, and all sorts of riot and disorder ensued. In less than a fortnight, as was stated to me, damage was done to the amount of more than two hundred pounds —more than three years' salary of the drill-master. The chaplain exhorted and prayed; the masters flogged, and flogged, and flogged; but without effect, as flogging did not touch the seat of the depravity—irritation from the deficiency of physical exercise. At last, the chaplain and the manager besought the restoration of the drill-master and the physical exercise he directed. This was done. The demands of physiology were satisfied, there was quiet sleep in the dormitories; and so it has gone on. Now, wheresoever

we hear of any disorder and rebellion in schools—wheresoever there has been extensive truancy, we may be sure that it is the system or the managers that are in the wrong. At this Institution, at the beginning, there was frequent truancy, but as improvement proceeded, as excessive sedentary constraint was reduced, as the improvements took place in the physical and other exercises, truancy has diminished, and it is now reckoned only in units where it was formerly reckoned in tens.

The half-school-time-principle of instruction, which when properly conducted involves simultaneous class-teaching, is to be credited with a large reduction of school irritation, from the reduced school time. In the common national and other small schools, the single master has at least six classes in as many distinct conditions to deal with, and he can only give effectual tuition to one class at a time. Meanwhile, the others are kept waiting in a state of constraint and irritability. Go into one of the schools, and you soon hear the master's denunciations of disorder, and "namings" and threatenings. In a properly organized half-time school, with simultaneous class-teaching, in which each class has its separate teacher, who attends to that class and no other, the child has no waiting, has no time to think of anything but of the work before him, from the time he enters till the time he leaves the school. By this continuous direct teaching his powers of mental receptivity are exhausted, within the reduced hours, though with an increased interest in the work—if the teaching be good. It is due, however, to sanitation to state, that the half-time teaching being much the same, the later Sanitary improvements have been attended by a reduction of the sickness and death-rates; while the manager states that now "a striking moral aspect has presented itself in connection with our Sanitary improvements; "the children are far better in temper and disposition than they used to be." These calisthenics, this music for their guidance, which to the common eye are expensive and misbefitting luxuries, are in the experiences of Sanitary Science, "formatives" necessary to impart mobility to all parts of the frame, to get rid of clumsiness and to augment health and productive force:—the objects of an economical administration. Now what are the moral and economical results of this mixed mental and physical training on the half-time principle? Formerly, in the era of parochial administration, in the small long-time schools, there was scarcely one out of three of those who had left the parish workhouse schools found in self-supporting occupations. They were found in large proportions amongst the prison populations.

The children of these half-time drilled institutions are found in prison in such proportions no longer: and strictly speaking, they are not found there at all. Allowance being made for cases of irretrievably bad bodily and mental conditions approaching to idiotcy,—all but a very small proportion are found in good places of self-supporting industry. With them hereditary pauperism, mendicity, and criminality are extinguished. But what is the cost of this teaching and training power; what the results of the training by the series of school teachers, drill-masters, and bodily trainers? As to the scholastic results, the gain is in years of life, as well as in hours of days made available for productive industry. Including the infant-school teaching, the children on the half-time system attain, by the tenth or eleventh year, results nearly if not quite as good as those attained in the common national or voluntary, or long-time schools, while the cost is little more than one pound per head per annum of the children taught, or less than one-half the cost of the London School Board. Including good teaching in the infant school stage, the three R's are imparted in the five years, at little more than £1 per head, including the physical training, as against more than £2 per head for seven years, without the physical training; gaining two years of time for secondary instruction, with further physical and industrial training; while the long-time National and Board-schools, exclude from advanced secondary education the great bulk of the population who cannot usually afford to keep their children at school beyond their thirteenth year. Thus the general result of the combined mental and bodily training on the half-school-time principle is to give to two of such children the efficiency of three on the long-school-time principle for productive occupations.

To conclude for this occasion. It has been accepted as a general proposition, that disease is generated by massing large numbers together; that is to say, massing them in ordinary conditions; and in those conditions the proposition is doubtless true. By the working of this Institution, and of others on the half-time principle, with the light of Sanitary Science, "massing numbers together" is proved to be a great preventive of epidemics, and a means of reducing sickness and mortality to the lowest point of which we have known examples. In education it is held that "massing children together in large numbers" is detrimental to them morally; and that teaching—meaning popular elementary teaching—in small schools is the best. And this is commonly so where large numbers are massed together, and kept together during long hours of

sedentary constraint, in violation of the laws of physiology, under exactions of mental tasks beyond the children's power of mental receptivity. But where the half-time principle is properly understood and applied as it has been in this Institution, in combination with simultaneous class teaching, the highest results are produced in morals and intelligence for productive occupation, as tested by the outcome.

To avoid the influence of the Union-house, in which two-thirds of the orphan children chargeable on the poor-rates,—in contravention of the original principle of classification in separate houses,—are brought up in small numbers in contact with adult paupers, arrangements have been made in some instances on a plan under which some twelve or sixteen children are to be brought up in what are called cottage homes, under one master, whose influence is intended to stand in the place of home influence. The scholastic work on this small scale, can only be made equally good at an excessively disproportionate expense, whilst the plan omits all the high and varied physical training which is carried out on the large scale on the half-time principle, and which produces the highest result, mentally as well as physically. Intending to strengthen the mind, which they fail largely to do, the common long-time small schools certainly weaken the body, and reduce the aptitude for productive service. In efficient half-time institutions it is demonstrated that a course of effective teaching need not be a course of misery and repulsive operations with the subject-matter taught, and that the highest results are obtainable in a course of playful and pleasurable interest. I repeat, as it is essential to be kept in view—for economical reforms in the fore—that "barracking" children, like barracking adults, in insanitary conditions, is productive of physical and mental and moral disorder. Whilst "barracking" them, in sanitary conditions, as here, is productive of the highest result of any yet achieved, demonstrated by superior outcomes.

Mr. Matthew Arnold has created a sensation, amongst ratepayers, by the statement that the cost of the long-time elementary education in France is about 18s. per head per annum of the pupils taught, and he leaves it to be inferred that the education given is the equivalent of the elementary instruction given in the Board schools and other long-time schools in England at more than a double cost. I might cite evidence to show that the condition of the great body of the elementary school teachers in France is a condition of extreme and dangerous poverty, which could not be endured in England, and can only be retrieved in France by an

organization of elementary teaching on the half-time principle with larger aggregations, such as the present, for simultaneous class teaching and training.

It is a grievous default in the administration of our educational system, that it cuts off from the observation of the Central Department the most important examples, such as those of this Institution, affecting the whole field of national education, by placing them under a distinct and independent authority. Had Mr. Arnold been in a position to be informed, he would have been aware of the fact I have stated, that at a cost little more than that in France —or, as stated, for little more than £1 per head, for teaching and training power—we impart, with a superior mental instruction, a superior physical training, such as I believe to be of the highest need for the population of France.

The half-time principle has been studied by *confrères* of the Institute of France, who have approved of it. I got M. Jules Simon to see one of these Institutions, and during his term of office he took occasion to promote the introduction of physical exercises in the shape of military drill; but I am aware, from French officers of the Educational Department, that there is no class of schools there which has the equivalent of such physical training as that displayed in this and other district half-time schools. I am informed, however, that the half-time principle is now under high consideration in France for adoption as a means of overcoming the difficulty of extending elementary education there. That which Mr. Matthew Arnold refers to in France as the equivalent of the common long school-time elementary education in England is, however, the equivalent of only half—the inferior half of what is given here, and that may, *mutatis mutandis*, be given elsewhere at a vastly reduced charge for teaching and training power below that exacted for long-time teaching in the Board and National schools.

I solicited the Archbishop of Canterbury to examine this Institution. He did so carefully, and he has left the statement in the visitor's-book that he was much pleased with all he had seen.

For myself, I entertain the hope and the confident belief that there is not finality in any part even of what we have seen here. We have, however, I submit, seen enough to establish the conclusion, of which we must challenge examination and comparison, that further important improvement in the elementary education of the population must be under the guidance of Sanitary Science.

A vote of thanks was unanimously accorded to Mr. CHADWICK for his interesting Address.

On Saturday, the 26th of October, at the conclusion of the Sanitary Congress at Croydon, and previous to the delivery of Mr. Chadwick's Address, a party of the members, including Dr. Richardson, the President; Dr. Alfred Carpenter; Dr. de Chaumont, Dr. Lory Marsh, the Registrar of the Institute; and Major McCoy, the Secretary; made a thorough inspection of the North Surrey District Orphanage Institution, at Anerley, which contains between eight and nine hundred male and female children, collected from the different Poor law Unions within the district. The greater number of the children are from the lowest neighbourhoods, and their parents represent the lowest type in the metropolis—mentally, morally, and in physical condition. The visitors first went over the infants' department, where the condition of bright health and the cheerfulness of the infants were the chief subjects of observation. They were next shown exercises with wooden dumb-bells, performed by the boys to music. The girls have calisthenic exercises, directed by the music of an harmonium. Both girls and boys are taught swimming, and tepid baths are provided. The manager, Mr. Marsland, explained that such exercises might appear superfluous, but his experience taught him that variety in recreation or exercise was essential to cheerfulness and health. The children who are old enough are trained in industrial occupations: the girls in kitchen and laundry work; the boys in carpentry, tailoring, and shoemaking; all in the general work of the establishment. A large and well-appointed infirmary, being only about one-fifth full, was also inspected.

ADDRESSES TO THE WAGE CLASSES.

On the evening of Saturday, November 8th, on the occasion of the close of the Exhibition, a meeting free to all wage-earning classes was held in the Public Hall. The chair was taken at 8 P.M. by Dr. Richardson, F.R.S., the President of the Congress, and the business commenced by the Secretary, Major McCoy, reading the awards made by the Judges and other Exhibitors at the Exhibition. The awards and the report of the Judges will be found at page 346.

ADDRESSES TO THE WAGE CLASSES.

The President, Dr. Richardson, F.R.S., delivered the following Address:—

On Health at Home.

The old saying, there is no place like home, has a singularly happy meaning when it is applied to health and the benefits which spring from health that is good and beautiful. We who are engaged in forwarding Sanitary work may labour our lives out and still do little service until we can get each home, however small it may be, included in the plan of our work. The river of national health must rise from the homes of the nation. Then it will be a great river on which every blessing will be borne.

The placard calling together this meeting specially invites ladies—I had rather it had said women—to be present. It is worded in this fashion because we who have invited know that women are always at home as men are always abroad, and that the woman who is at home must be the continuous and natural guardian or ward of the health that should centre in the home. When I, as a physician, enter a house where there is contagious disease, my first duty is to look at the surroundings. What are the customs of the people there, are they wholesome, are they unwholesome? If the answer be "wholesome and common sense," then I know that the better half of success in the way of treatment and prevention is secured. If the answer be "unwholesome, slovenly, disorderly, careless," then I know that all that may be advised for the best will be more than half useless, because there is no habit on which any dependence can be truthfully placed, and because habit in the wrong direction is so difficult to move that not even the strongest ties of affection are a match for it in times of emergency.

If we could then get wives and mothers to learn the habitual practice of all that tends to health, we should soon have an easy victory, and should ourselves cease to be known as the pioneers of Sanitary work, the work itself being a recognized system and a recognized necessity practised by everybody.

In the few minutes at my disposal let me try and tell you what, after many years of experience and observation, seems to me to be a few golden rules for securing health at home.

1. SUNLIGHT AT HOME.

1. Whether your home be large or small give it light. There is no house so likely to be unhealthy as a dark and gloomy house. In

a dark and gloomy house you can never see the dirt that pollutes it. Dirt accumulates on dirt, and the mind soon learns to apologize for this condition because the gloom conceals it. "It is no credit to be clean in this hole of a place" is soon the sort of idea that the housewife gets into her mind; the "place is always dingy, do what you may," is another similar and common idea; and so in a dark house unwholesome things get stowed away and forgotten, and the air becomes impure, and when the air becomes impure the digestive organs become imperfect in action, and soon there is some shade of bad health engendered in those persons who live in that dark house. Flowers would not healthily bloom in such a house, and flowers are, as a rule, good indexes. You put the flowers in your windows that they may see the light. Are not your children worth many flowers? They are the choicest of flowers. Then again light is necessary in order that the animal spirits may be kept refreshed and invigorated. No one is truly happy who in waking hours is in a gloomy house or room. The gloom of the prison has been ever considered as a part of the punishment of the prison, and it is so. The mind is saddened in a home that is not flushed with light, and when the mind is saddened the whole physical powers soon suffer: the heart beats languidly, the blood flows slowly, the breathing is imperfect, the oxidation of the blood is reduced, and the conditions are laid for the development of many wearisome and unnecessary constitutional failures and sufferings.

Once again, light itself, sunlight I mean, is of itself useful to health in a direct manner. Sunlight favours nutrition; sunlight favours nervous function; sunlight sustains, chemically or physically, the healthy state of the blood. Children and older persons living in darkened places become blanched or pale; they have none of the ruddy healthy bloom of those who live in light. You send a child that has lived in a dark court in London for a few days only into the sunlight, and how marked is the change You hardly know the face again.

Keep, then, this word in your minds, light, light, light; *sun*light which feeds you with its influence and leaves no poisonous vapours in its train.

Before I leave this subject, I want to say a word about light in relation to the sick. A few hundred years ago it became a fashion, for reasons it is very hard to divine, to place sick people in dark and closely curtained bedrooms. The practice to some extent is continued to this day. When a person goes to bed with sickness, it is often the first thing to pull down the blinds of the windows, to set up dark blinds, or if there be venetian blinds to close them. On body and spirit alike this practice is simply pernicious. It may be well, if light is painful to the eyes of the sufferer, to shield the eyes from the light, or even shut the light off them altogether; but for the sake of this to shut it out of all the room; to cut off wholesale it precious influence; to make the sick room a dark cell in which all kinds of impurities may be concealed day after day, is an offence to nature which she ever rebukes in the sternest manner.

This remark presses with special force in cases where epidemic

and contagious diseases are the affections from which the sufferers are suffering, for these affections as they live on uncleanliness require for their suppression the broadest light of day. Moreover, I once found by experience, that certain organic poisons, analogous to the poisons which propagate these diseases are rendered innocuous by exposure to light. Thus in every point of view, light stands forward as the agent of health. In sickness and in health, in infancy, youth, middle age, old age, in all seasons, for the benefit of the mind and the welfare of the body, sunlight is a bearer and sustainer of health.

2. SLEEP AT HOME.

I have been speaking about sunlight, and am led by this to refer to another and allied topic—I mean night and hours of sleep. If it be good to make all possible use of sunlight, it is good equally to make as little use as possible of artificial light. Artificial lights, so far, have been sources of waste, not only of the material out of which they are made, but of the air on which they burn. In the air of the closed room the present commonly used lamps, candles and gaslights, rob the air of a part of its vital constituent, and supply in return products which are really injurious to life. Gaslight is in this respect most hurtful, but the others are bad when they are long kept burning in one confined space. The fewer hours after dark that are spent in artificial light the better, and this suggests, of itself, that within reasonable limits the sooner we go to rest after dark the better. We require in the cold season of winter, when the nights are long, much more of sleep than we do in the summer. On the longest day in the year, seven hours of sleep is sufficient for most men and women who are in the prime of life; on the shortest day, nine hours is not over much, and for those who are weakly, ten or even twelve hours may be taken with real advantage. In winter, children should always have ten to twelve hours of sleep. It is not idleness to indulge to that extent, but an actual saving, a storing up of invigorated existence for the future. Such rest can only be obtained by going to bed very early, say at half-past eight o'clock or nine.

It is really all wrong, at the present season, that we should be here robbing ourselves of sleep. It is wrong as ever it can be that our Legislators should often be sitting up, as we know they do, times after times, in the dead of night, trying against life to legislate for life. It is most foolish that public writers who hold so many responsibilities in their hands, should be called upon to exercise their craft at a time when all their nature is calling out to them, rest, rest, rest. It is said I am foolish for declaring these things. Is it so? I am standing by Nature, speaking under her direction, and, without a thought of dogmatism, I am driven to ask:—May it not be the world that is foolish?—the world, I mean, of fashion and habit, which could if it would change the present systems as easily as it criticises the view that it ought to make the change. Any way this I know, and it is the truth I would here express, that in every man, woman, and child there is, at or about the early time I have named, a

persistent periodical desire for sleep which steals on determinately, which, taken at the flood, leads to a good sound night's rest, and which resisted never duly returns, but is replaced by a surreptitious sleep, broken by wearing dreams, restless limbs, and but partial restoration of vital power. I said the other night in this room, make the sun your fellow workman. I repeat the saying now. I do not say, go to bed at all seasons with the sun, and rise with it, because in this climate that would not be at all seasons possible; but I say, as a general principle, as closely as you can, make the sun your fellow workman; follow him as soon as you are able to rest, and do not let him stare at you in bed many hours after he has commenced his daily course. Teach your children, moreover, this same lesson, and the practice of it, whereupon there will be, in a generation or two, even in this land of fogs and dulness, a race of children of the sun who will stand, in matter of health, a head and shoulders above the children of this present generation.

3. BEDS AND BEDROOMS AT HOME.

The mention of sleep causes me to say a word about beds and bedding and bedrooms. It is a point of the greatest importance in a healthy home to let every person in the house have a separate bed. It is a most unhealthy practice for two persons of any age to sleep in the same bed. Every person requires some different condition from everyone else in order to secure perfectly good repose. Take children as an example. One child requires more bedclothes than another, or a different kind of bed, or a different position before sound sleep can be secured; and this can only be obtained by giving a separate bed to each child. Then again, when two children sleep together, they are subject to the breath of the one or the other, and if both be quite natural it is bad; but if one be unnatural it is very bad; and if both be unnatural it is seriously bad. Near here, at this moment, a great experiment has been tried on this question with the most striking results. At the schools at Anerley every scholar has his or her own bed; and the wise authorities there,—who have improved the health of the children under their charge until the mortality is reduced to three in the thousand annually,—tell me that few things have contributed so much to the grand results they have achieved as this one practice of having a separate bed for every child. It is important to have always a well made bed, and everybody should learn to make a bed. A very soft or a very hard bed is a bad bed. The bed should be sufficiently soft to allow all parts of the body to feel equal pressure and yet not so soft as to envelope the body. The clothes should be laid on lightly, not be closely tucked in. The clothes should be light as well as warm. Dense blankets and coverlets are always unwholesome. Every portion of the bedclothes should be every day spread out for a short time to the air. I do not object to light bed-curtains at the head of the bed: they keep off draught, they keep the light from the face of the sleeper, and they neither prevent the entrance of air nor light.

I must add one word about bedrooms. It should always be remembered that the bedroom is the apartment in which one-third, at least, of the whole life is passed, and this remembrance should suggest that the bedroom ought to be the room on which most trouble after health should be bestowed. The rule that is followed is, with few exceptions, the reverse of this. The sitting room and the drawing room are made subjects of the greatest attention; but the bedroom may be small, close, at back of the house, at front of the house, anywhere, if it be but convenient to get at. It may not even have a fireplace; it may have the smallest window. It is often half a lumber room, a place in which things which have to be concealed —old boots and shoes, old clothes, old boxes—are put away. Its walls, covered with several layers of paper, may be furnished with pegs, on which to suspend a wardrobe of garments, and it is constantly decorated, for snugness' sake, with heavy curtains and blinds at the windows, and carpets all over the floor. These errors are unpardonable, and health at home is impossible where they are committed. The bedroom should be so planned that never less than four hundred cubic feet of space should be given to each occupant, however good the ventilation may be. The walls should be coloured with distemper or with paint, that, like the silicate paint, can be washed three or four times a year. The windows should have nothing more than a blind and a half muslin curtain. The floors should have carpets only round the beds, without valances from the beds. The furniture should be as simple and scanty as is possible; the chairs free of all stuffings or covers that can hold dust. Of all things, again, the room should be kept clear of vestments that are not in use. From time to time a fire should be made in every bedroom, that a free current of atmospheric air may sweep through it from open doors and windows. I need not say that the floors should be kept scrupulously clean, but I would recommend dry scrubbing as by far the best for this purpose.

4. THE BATH AT HOME.

To secure health at home some simple provision should be made by which the body of every person who lives at home may be subjected to the bath. This wholesome process is frequently neglected from the excuse that there is no convenience for a bath. The excuse is more plausible than real. A formal bath is not at all necessary. A shallow tub, or shallow metal bath, in which the bather can stand in front of the washhand basin; a good sponge; a piece of soap; two gallons of water, and a good large towel, are quite sufficient for every purpose of health. To stand in the shallow bath, and from the washhand basin to sponge the body rapidly over from head to foot, and afterwards to dry quickly is everything that is wanted if it be carried out daily, and this may be so easily done, after a little practice, that it becomes no more trouble than the washing of the face, neck, and hands, which so many people are content to consider a perfected ablution. In winter time the water should be tepid, in summer cold; and once a week there should be dissolved in the two gallons of water a quarter of a

pound of fresh washing soda. This addition cleanses the skin effectually and removes acidity.

5. THE AIR AT HOME.

In order to secure health at home it is necessary to maintain, as far as can be, an equal temperature in the different rooms—a temperature of 60° Fahr. is nearest to the best—a free access of air without draughts, and, above all things, an air that is dry. Washing days at home amongst the poor are the days of most danger to the young. In the damp atmosphere, colds, sore throat, and croup find easy development; and in a house persistently damp from any cause, consumption of the lungs is induced as if under an experiment devised for the express purpose of production.

6. ANNUAL CLEANSING AT HOME.

From the more strict of our Jewish fellow-subjects I take my last lesson for "Health at Home." Their system of complete household cleansing once a year, the cleansing of every article, great and small, of every wall and floor and door and lintel, and the removal and destruction of all organic refuse, however minute, is a practice which above all others has so saved this wise and discerning people from the scourges of the great plagues, while all around have been stricken and destroyed, that a marvellous preservation has more than once accounted for what was a mere natural sequence and natural necessity. Health at home calls for this salubrious physical sanctification in every domestic centre and circle once a year at least.

And now I leave my learned colleagues to descant on ventilation, good food, good air, and other accessories to health everywhere, at home and abroad. And though by our united efforts we may not essay to lead you direct to Salutland and its hundred years of happy life, we shall take you, if you will go with us, a long way towards even that promised commonwealth of health and long life.

B. W. Richardson, M.D. F.R.S.

Health and Good Food.

In order to get a clear idea of the bearing of the question of food and its use in the body, we must be prepared to look upon man as a mechanical engine. As science advances we see this more clearly, and can observe how strictly all our actions and functions are regulated by physical laws. It is therefore by obedience to those laws that we shall obtain the best results, whilst if we oppose them we shall assuredly pay the penalty. The necessity for this obedience is plain to all in the rougher matters of physics, although it is not so generally admitted in the finer kinds that have to do with our bodily functions. Thus everybody knows that if he goes up to a second or third story and comes down again by jumping

out of the window instead of using the stair, he will assuredly come to most serious grief. But many persons do unwittingly as great injury to themselves in the long run by sins against physical laws in the management of their own bodies. An engineer knows that unless he stokes his engine-fire he will get no work out of his engine, but men often try to get work out of their bodies without stoking the fire properly—that is, without supplying the necessary amount of food of proper quality. There is, however, this difference between our bodies and a mechanical engine, that, whereas the latter will yield no work without stoking, the former may do so for a certain time. How is this? The obvious answer is, by consumption of the engine itself, and in this lies the peculiarity of the animal or human engine; the supply of food does the double work of furnishing energy and repairing worn structure. The wonderful mechanism by which the body is put together permits of oiling, repairs and coaling going on without interrupting the actual work. We require, then, food proper to fulfil all those functions—mineral matter to build up our skeleton, nitrogenous matter to repair the softer tissues, and carboniferous matter, which may be burned off by the oxygen we take in through the lungs, in order to supply energy for active work. Again, we find that we must regulate the food according to the work done, a larger quantity being necessary when the amount of work is increased. If, on the other hand, we take more food than is actually required for our work, it can within certain limits be stored in the body and afterwards utilized, but if this is done habitually it either leads to corpulence or to disease. On the other hand, if the amount is too little for our work, we can still go on for a certain time doing our work at the expense of our body. First, the fat is used up, and this in some cases is not a bad result, but then after that the muscles and other tissues begin to suffer, and sooner or later the wasteful process must end in disease and death. Among the well-to-do classes the chief danger is from over-feeding, with the result of throwing upon the liver, heart and other organs an amount of work they cannot accomplish; hence arise various diseases, indigestion, palpitation, liver-complaints, gout, &c. Among the poorer classes the danger is too often from under-feeding, and this is especially the case with the women and children. This is one of the causes of the excessive death-rate among children in those classes; they are underfed as infants, in consequence of which they either perish or live to grow up ill-formed and unhealthy, and afterwards to give birth to offspring who add inherited bad health to the other evils that await them. Sometimes people think little of a period of starvation (when it does not immediately affect themselves) and are under the impression that its results are soon recovered from; some people again voluntarily fast, either for the good of their health or as a religious rite, or perhaps through sheer negligence; some again do it by way of scientific experiment; whilst not a few do it involuntarily by way of punishment. Now it is important to know that even a temporary starvation is a much more serious thing than most people imagine, and there seems good reason to believe that serious con-

sequences may be traced to this cause, which has up to lately been only slightly suspected. A most important paper has been written within the last year by Dr. D. D. Cunningham, of the Indian Medical Service, in which he gives an account of his researches into the effects of starvation on both plants and animals. He there shows that when they are deprived of nourishment for a certain time a series of changes go on in their structures which are not easily recovered from, and, if they are prolonged too far, are quite beyond all repair. The living membrane of the stomach and bowels, on the good condition of which all the nourishment of our body depends, undergoes a peculiar and fatal form of decay, so that even if food be supplied it cannot be digested or taken up into the body for use; it consequently becomes irritating instead of nourishing and the cause of death in place of life.

In this way we can explain the terrible mortality in Indian famines, especially in the camps of relief, and the hopelessness of trying to remedy the mischief after it has reached such a pitch. The proper way is to prevent, if possible, the occurrence of such calamities, by every measure that lies in our power. But this has a serious application nearer home; if even the temporary loss of proper food is so dangerous an evil, how doubly responsible is the man who spends on his vicious indulgence the money that ought to feed his wife and children! It also affects in a very serious way the question of strikes, which have assumed so much importance of late years. I am not going to discuss the point here, as to whether or not strikes are an advisable way of trying to raise the market value of labour, but I think it is a question that well deserves careful consideration, whether or not strikes, with their attendant misery and starvation, are not a most fatal weapon to use, even when they are apparently successful. That wages are lost in the struggle we know, but it ought also to be known that health may be, and doubtless often is, lost at the same time; with this sad difference, that the loss of wages may be made up in aftertimes, but the loss of health in too many cases never can be so repaired.

But there is more than one kind of starvation. I have up to this time spoken of more or less complete deprivation of all food; but there is partial starvation by deprivation of one particular kind of food—and this is not only common, but among the poorer classes of the people almost universal. One particular kind of this form of starvation has been more the subject of inquiry perhaps than any other—namely, that which depends upon the loss of vegetable food, more especially what are called green vegetables, and fruit. The consequence of such starvation is known as scurvy, a disease formerly very common in the northern or colder parts of Europe,—a disease which used to be the terror of our navies and our merchantmen, and which ever lies in wait for armies, sometimes even in their hour of victory. Happily, the cause of the disease is known and its remedy, so that now, by the aid of lime-juice, we can send our ships to sea without fear, and scurvy is but little known now, except where ignorance, greed or obstinacy on the part of commanders leads them to expose those under them to its terrible

ravages. I have been myself a witness to the havoc it created in the Crimean War, and we should have had a somewhat sad story to tell of our late occupation of Cyprus, had it not been for the abundance of grapes and other fruit in the island. But apart from those terrible and startling outbreaks of the disease, I am sure a good deal of it exists in a milder form among a large number of people in this country, on account of the neglect of vegetable food. It is a good thing that potatoes have become so general an article of diet, as they are excellent remedies for scurvy; but half the good they do is lost in our way of cooking them. By peeling them before cooking, the most valuable part of the juice is lost; they ought to be boiled in their skins, or steamed, or, if it is necessary to cut away portions when they are not very good, they should be stewed or made into a soup, so that the liquor they are cooked in is consumed as well. But should potatoes fail, every effort should be made to procure green vegetables, such as cabbage and the like, and onions, as the best substitutes.

Another form of starvation is the want of nitrogenous or flesh-forming food. This food is best known in the form of meat, eggs, cheese, or milk; but it exists in large quantities also in flour, oatmeal, Indian meal, and especially in beans, peas, and lentils. These last—beans, peas, and lentils—are most nourishing, and ought to be much more used than they are: they contain much more of the flesh-forming food than the best meat, and would form a cheap and excellent substitute when meat is dear. Meat itself, too, would be much more usefully and economically prepared by being made into a soup or stew with vegetables, instead of the wasteful process of grilling or roasting.

Another form of starvation is the want of fat, and this is very frequent, on account of the dearness of most kinds of fat. Fat is a most essential thing, and no hard work can be well done without it. Children suffer especially from the want of it, and there is little doubt that deprivation of fat is one serious influence in the production of that terrible disease, consumption. Indeed, one eminent physician used to express the opinion that consumption in England was due to the high price of butter. Although not all the truth, it is still in a large measure true; and certainly if children could be more generally fed on milk in their earliest years, and get a fair share of butter when able to eat it, they would be not only more healthy themselves, but would also be the parents of a healthy offspring. As it is, infants are too generally fed with bread or biscuit sop, corn-flour, or such like starchy foods, which the poor little stomach does not know what to do with, for digesting it is impossible; pain is the result, the poor little thing cries and gets slapped by its mother for being fractious; whereas it is rather the mother that ought to suffer for feeding it wrongly. I do not wish, however, to throw too much blame upon her, seeing that she is too often so heavily weighted with want of knowledge and poverty.

F. de Chaumont, m.d., f.r.s.

Health and Good Air.

There can be no health without pure air. Impure air either inside or outside your houses entails sickness and increased mortality. There is no better barometer to show the constitution of the air than children.

In towns where the buildings are crowded together, and there is no circulation of air, the pale faces of the children show that they suffer from want of air.

The air of a town is less pure than the country air, because of the quantity of particles of impure matter with which it is filled. Town air contains particles of soot and sulphurous acid derived from the burning of coal, is full of dust from the streets, which is mainly formed of horse dung; the act of breathing throws out particles of matter from the body; similarly the sewers pour out their gases, and all these particles float in the air, until the oxygen of the air can act upon them, and alter their character.

There is formed in abundance in pure country air a substance called ozone, which consists of oxygen in a peculiar condition, and which acts with great rapidity in altering the organic matter which floats in the air. In town air this substance rarely exists, as it seems to be rapidly used up in endeavouring to destroy the impure emanations with which town air is filled. A friend of mine told me that he had recently made experiments on the ozone in the air on the pier at Brighton, and that when the wind blows from the sea he found plenty of ozone; when it blew directly over the town he found scarcely any.

Then impure matters, suspended in the air, hang about in the lower strata; as you ascend the air is purer, at 100 feet high they are greatly diminished; at 300 or 400 feet high the air is nearly pure.

However impure the air of a town may be, the condition of air in a house must be still more impure.

The movement of air out of doors averages 12 miles an hour or 17 feet in a second. This movement is rarely less than from 4 to 5 miles an hour or 6 feet in a second.

Imagine a frame about the height and width of a human body, measuring about 6 feet by $1\frac{1}{2}$, or 9 square feet: multiplying this by the velocity of movement of the air at 6 feet a second, it will appear that in one second 54 cubic feet, in one minute 3,240 cubic feet, in one hour 196,400 cubic feet of air would flow over one person in the open.

In a room the conditions are very different. The main source of impurity in a room in which people are congregated arises from the effect produced on the air in the process of breathing. In this process—1. The oxygen is diminished. 2. The carbonic acid is increased. 3. A large amount of watery vapour is produced. 4. There is an evolution of ammonia and organic matter. 5. A con-

siderable amount of suspended matter is set free, consisting of epithelium and molecular and cellular matter, in a more or less active condition of putrefaction. At the same time, portions of epithelium are constantly being given off from the skin, and even pus cells from suppurating surfaces; as, for instance, with surgical cases in hospitals.

I will mention two well-known standard cases of the effect of want of fresh air in a confined space, viz:—the well-known cases of the Black Hole at Calcutta, and the steamship "Londonderry."

In the year 1756, 146 individuals were confined in a small cell, known as the Black Hole of Calcutta. This cell was 18 feet long by 14 feet wide by 10 feet high, being so small that the last person of the 146 had to be crushed in upon the rest with violence as the door was closed and locked. The only means of ventilation were two small holes. In the morning 123 corpses were taken out, and 23 beings, who could scarcely be said to be alive.

The steamship "Londonderry," left Sligo for Liverpool, on 2nd December, 1848, and stormy weather coming on, the captain forced 200 steerage passengers into their cabin, which was 18 feet by 11 feet and 7 feet high. The hatches were battened down, and covered with tarpaulin. When the cabin was opened, 72 persons were found dead, and several expiring.

These were deaths caused by breathing over again air which had been previously breathed without any addition of fresh air to dilute it.

If it were desired to supply in a room a volume of fresh air comparable with that supplied out of doors, it would be necessary to change the air of the room from once to five times in every minute, but this would be a practical impossibility; and, even if it were possible, would entail conditions very disagreeable to the occupants.

Hence, to maintain the comfort and temperature we desire indoors, we sacrifice purity of air. Therefore, however impure the outer air is, that of our houses is less pure; and it may be accepted as an axiom that by the best ventilating arrangements we can only get air of a certain standard of impurity, and that any ventilating arrangements are only makeshifts to assist in remedying the evils to which we are exposed from the necessity of obtaining an atmosphere in our houses different in temperature from that of the outer air.

In fixing the standard of purity or impurity in air regard must be had to the moisture of the air, it must not be too dry or too moist. The moisture is measured by the difference between wet and dry bulb thermometer. This difference should not be less than 4° Fahr., or more than 8° Fahr. The maintenance of a certain amount of purity or impurity in a building depends on the ventilating arrangements.

We are told by theory that a room containing an air space of 1000 cubic feet, occupied by one individual, would require to be supplied by 3,000 cubic feet per hour, in order to maintain it in a proper condition of purity and humidity. But in our temperate climate, a careful practical examination of the condition of barrack-rooms and hospitals, judged of by the test of smell, showed

that arrangements which appear to provide for a volume of air much less in amount than that obtained by calculation will keep the room in a fair condition.

From similar experiments made in soldiers' barracks, these results have pointed to about 1200 cubic feet of air admitted per man per hour in barrack-rooms occupied by persons in health.

This need not be set down to errors in calculation or in theory.

There are many data which cannot be brought into the theoretical calculation. For instance, the carbonic acid disappears in a newly plastered or lime-washed room, and could be recovered from the lime; therefore a newly cleaned, lime-washed room will present different conditions from a long-occupied, dirty room. Washing with quick-lime destroys fungi in dirty walls; the same effect is produced by sulphurous acid fumigation. Air has the same property, especially dry air; and hence, opening windows, turning down beds, and all such measures, act directly on the subsequent state of the air. Therefore an enormous effect is produced on all the elements of the above calculation if the windows of a room are kept open for several hours a day, instead of being closed.

Besides this, the conditions under which the air flows in and out of a room are so varied. The walls and ceiling themselves allow of a considerable passage of air.

The ceiling affords a ready instance of porosity. An old ceiling, it will be observed, is blackened where the plaster has nothing over it to check the passage of air, whilst under the joists, where the air has not passed so freely, it is less black. On breaking the plaster, it will be found that its blackness has arisen from its having acted like a filter, and retained the smoky particles, while the air passed through.

Ill-fitting doors and windows allow of the passage of a considerable quantity of air.

In a temperate climate, where the changes of temperature of the outer air are rapid and considerable, these means of producing the outflow from and the inflow of air into a confined space are in constant operation.

Le me give you an instance—

Thus a bed-room twelve feet by fifteen feet and nine feet high, which is generally considered a sufficiently large room for one person, requires, if a proper degree of purity of air is to be maintained in it, that the air should be renewed at the rate of about 1880 cubic feet per hour for each individual occupying it. In a common lodging-house, six persons could, under the Act, sleep in such a room; the air to be removed and the fresh air to be admitted for this number will be 11,200 cubic feet per hour. If the room had a fire at bed-time the velocity of air in the flue at about three or four o'clock in the morning would probably, with an ordinary average outside temperature, be about two feet per second. An ordinary flue of fourteen inches by nine inches would under such conditions remove about 6500 cubic feet per hour; but the law makes no provision for flues in sleeping rooms, except in the case of cellars; and, moreover, the absence of inlets for fresh air to replace that

drawn off by the chimney-flue materially checks the draught in the flue. If in such a room no arrangement is made for the renewal of the air, in a ten hours' period of night occupation of the room, the amount of carbonic acid and other emanations from each occupant diffused through the air would be ten times as great as the usual amount in fresh air; and with the six occupants might be fatal. The safeguard in practice against such extreme vitiation is the badly-fitted doors and windows, through which some exchange of air takes place, and the exchange is much accelerated by the lowering of the temperature of the outside air during the night.

In rooms occupied as living rooms the air deteriorated by the burning of lights must be provided for in addition to that due to the occupants, and (as shown above) an ordinary gas burner deteriorates the air as much as six individuals at least. These facts bring home to the mind the importance of providing in a systematic manner for the renewal of the air of all inhabited space: that is to say, the removal of the vitiated air, and the introduction of fresh air.

It may be summed up that, whatever the cubic space is, the air in a confined space occupied by living beings may be assumed to attain a permanent degree of purity, or rather impurity, theoretically dependent upon the rate at which emanations are given out by the breathing and other exhalations of the occupants, and upon the rate at which fresh air is admitted, and that, therefore, the same supply of air will equally ventilate any space, but the larger the cubic space the longer it will be before the air in it attains its permanent condition of impurity. Moreover, the larger the cubic space, the more easily will the supply of fresh air be brought in without altering the temperature, and without causing injurious draughts. One of the chief difficulties of ventilation arises from the draughts occasioned thereby. Everyone approves of ventilation in theory, but practically no one likes to perceive any movement of air.

These conditions point to the care which should be exercised in the form of rooms, the position of windows, doors, fireplaces, and other matters. We should study how the currents of air move in a room: what is the effect of the form of a room on the circulation of these currents of air: for instance, a lofty room with the tops of windows some distance below the ceiling, and without outlets for air at the ceiling-level, becomes dangerous, unless a constant circulation of air goes on, because the heated air, loaded with impurities, ascends, stagnates in the space near the ceiling, cools, and falls down, and re-mixes with the air in the lower part of the room, and thus increases its impurity.

These effects are modified by anything which causes circulation of the air. The open fireplace creates circulation of air in a room, with closed door and windows. The air is drawn along the floors towards the grate; it is then warmed by the heat which pervades all objects near the fire, and part is carried up the chimney with the smoke, whilst the remainder, partly in consequence of the warmth it has acquired from the fire, and partly owing to the impetus created in its movement towards the fire, flows upwards

towards the ceiling near the chimney breast. It passes along the ceiling, and, as it cools in its progress towards the opposite wall, descends to the floor, to be again drawn towards the fireplace.

Thus the open fire, whilst continually removing a certain quantity of air from the room, which must be replaced by fresh air, causes an efficient circulation of the air remaining in the room.

It is impossible in the short space allotted to me to give you a lecture on ventilation, and its accompanying science, warming. Warming and ventilating must go hand-in-hand in this climate. The reason why ventilation is so much objected to, and so little practised is because people endeavour to bring in fresh air in cold weather without tempering it. In a large room, well warmed, you may by judicious arrangements bring in cold air to the large mass of warm air in the room without discomfort, but in a small room where the volume of air flowing in more nearly approaches that of the air in the room, you must temper the air in cold weather before admitting it, if you are not to feel a draught.

In conclusion let me urge upon you to think upon this matter. Sanitary Science is made up of simple principles which are within the reach of everyone to understand, and if you will only attend to these principles you will find your health and that of your children improved, and your power of work and usefulness vastly increased.

DOUGLAS GALTON, C.B., D.C.L., F.R.S.

Health and Pure Water.

THE first duty of an Englishman is one which I fear is less observed than it should be. In times past when Nelson signalled that "England expects every man to do his duty" it was understood that it was both a duty and a privilege to obey orders. Now-a-days, when we seem drifting into a condition when everybody is to be equal, and therefore nobody is to be master and nobody to issue orders, I do not quite see how things are to work equally well.

You probably wonder what this remark has to do with my subject. I am one of the old-fashioned type, who like to work under orders. Our President said, "Mr. Symons, you will take ten minutes for Pure Water." There were my orders, with the limits of time and subject—short, sharp, and decisive. It is a pleasure to obey such instructions, even if it is not very easy to carry them out.

Pure water. Well, to begin with. Considering the myriad sources of pollution and contamination which have prevailed not only since man came upon the earth, but even long before, is it not rather remarkable that there is a drop of pure water left? Look at the mass of foulness hourly poured into such rivers as the Clyde and the Irwell, by the side of which the Thames is purity itself. Look at the contamination from mining works, from manufactures (paper

for instance), from dye works, &c. Or, abandoning all thoughts of industrial appliances, pass in review the countless millions of human beings who have lived and died on this globe, of the still more countless millions of animals, cattle, reptiles, and birds, all which have had their share in contaminating the water supply of the earth. And even to this list we must add the fermenting juices of decaying vegetation, which in tropical regions are not to be ignored. Think of the thousands of tons—nay, mountains—of filth which have streamed down every river on the globe, and I am sure that you will agree with me that it is a marvel and a mercy that with trifling exceptions the water supply of the world is as copious and as pure as it was thousands of years ago.

I have not time to trace the various means whereby all this foulness is removed. I can only stop to remind you of two facts. Everybody who has started an aquarium knows that the secret of keeping the water bright and beautiful is to exactly balance the animal and vegetable life existing in it. And so on a larger scale, the weeds of our rivers extract much of the animal matter contained in the water, and what with weeds and what with the action of atmospheric oxygen upon the water, a dirty river may become almost clean ere it enters the sea. But a far stronger reason is in the fact that all our water supply, no matter whether we gather it on our roofs, dip it out of a brook, or pump it from the bowels of the earth, is rain. Rain is condensed vapour, but vapour raised from dirty water is clean. The sun may raise vapour from a filthy lagoon, but that vapour passes into a cloud purer than from the finest laboratory in Europe, the cloud floats off and bears its burden of pure water to the region where it is needed. If man does not get pure water, he has himself to blame for its contamination.

Considering the sharp lesson which water-works superintendents have received from a fatality in this neighbourhood, I need say nothing to a Croydon audience upon the desirability of their scrupulously guarding against the pollution of water required for food and for food utensils. But however pure the water may be when it flows through the street mains, that purity will be of little moment if the domestic fittings, and I must go further and say the domestic arrangements of the people, are not what they should be. Every traveller by rail knows that the waterbutt—that foul, slimy, open receptacle for blacks, leaves, and an etcetera which I will not specify—is far from extinct. People of a somewhat higher class get a little fright about bad water ; they rush off and buy a filter, and having done so, soon forget all about it and leave the poor filter to purify all the drinking-water of the household for all time to come. If the water wants filtering, it is obvious that the filter is intended to keep back some obnoxious substance, but if so, surely the filter itself must soon become clogged and noisome. My impression is, that when water requires filtering, the subject is altogether a more serious one than is generally supposed. In ordinary towns I do not think that filters do any harm, because the water is usually so good that there is little to pollute the filter, and even if

the filter is neglected for years the water probably passes out in much the same condition as if no filter were there.

One word before I leave this subject. I am no authority respecting filters. Do not attach any weight to my remarks except as far as the thoughts commend themselves to your judgment; and on no account regard them as an attack upon filters in general; what I complain of is the unintelligent misuse of filters. I do not attack their use, but their neglect.

The ordinary public are apt to look upon rain as a nuisance—and this year at any rate an excessive supply has cost the nation many millions sterling,—but as all our water comes from the rain the amount that falls in different districts is a matter of great public importance, although Government do not seem to think so; for they leave it to private enterprise to determine all the phenomena connected with its distribution. That, however, by the way. I have mentioned the subject because I thought it might be of interest to you to see a map which, by gradations of tints, shows the districts where the rainfall is greater and greater, the darker the colour the greater the fall of rain. Here, at Croydon, as Mr. Corden told us in his paper, the fall of rain is about 25 in., but the districts marked with the deepest tint have at least three times that amount, and in those districts are spots where the fall is four, five, six, and almost seven times as great as it is here. Need I say that these localities are veritable mines of the priceless treasure—pure water.

Several causes are tending to render pure water increasingly scarce in this country. Our population is increasing at a rapid rate, and therefore more clean water is required and more water is dirtied every year. The moorlands, whence much of our best drinking water comes, are yearly being brought into cultivation (which means treated with manures, &c., which will dissolve and run into the streams). Our rivers have many of them become rather sewers than rivers; and no matter how bright the effluent water of a sewage farm may be, it is hardly pleasant to be obliged to drink it. The tendency of our population to congregate in towns of great size, renders the providing of an adequate supply of pure water for their use a matter of great difficulty and magnitude, and, as there seem very strong reasons against the supply of two qualities of water to each house, the total volume of pure water required for our large towns is enormous. There has moreover sprung up a sort of rivalry in the promotion of big schemes; and as there is no public department to look after the subject, and the decisions are given by Private Bill Committees who never have the national bearing of the schemes brought before them, the result is, as I have said before, that the rich and the venturesome have it all their own way, and the committees hand over to them in perpetuity stores of water which, under a wiser *régime* would be duly administered for the benefit of the nation at large.

G. J. Symons, F.R.S.

Health out of Doors.

At the wish of Mr. Edwin Chadwick and by the kind invitation of the Chairman of the Schools' Management Committee (Mr. Wainwright), several members of the Sanitary Congress, with myself, paid a visit to the North Surrey District Schools at Anerley, when certain facts with regard to the method of education pursued there were made known to us, and were so remarkable that I hope you will excuse my bringing them again to your notice to-night.

As a ratepayer in Croydon I had known of the existence of these schools, but had never had the privilege of visiting them, or knowing so much of the internal management before the present occasion. The schools were first instituted in the year 1849, and were an outcome of a similar establishment on Westow Hill, kept by Mr. Aubin, where for many years children had been farmed from several London parishes; but after a Government inquiry, held in consequence of a serious outbreak of cholera and a large mortality, it was decided to build the present establishment, where children belonging to the four districts in North Surrey—Wandsworth, Lewisham, Richmond, and Croydon—should be sent, boarded, clothed, and educated, the expense of each child being defrayed by the particular union in which the parents of the child resided.

It is more especially with the method pursued and the extraordinary results achieved that I wish to claim your attention to-night.

All work is done by the children as far as practicable.

The domestic duties of the house, as well as making their clothes, are done by the girls. Agricultural, mechanical, and other labour is contributed by the boys as far as their age and the insufficient time at command for learning a trade will permit. Their number averages over 800, and they are only drafted here from the workhouses in the district, either from the poverty of or desertion by their parents. It is proper to add that when children are received here from the ages of three or four years, they are first placed in a probation ward for three weeks to ascertain if they are incubating any infectious disease, whilst both then and hereafter each child sleeps in a separate cot or bed. This has been found to exercise a great influence in promoting health and preventing disease.

I will not weary you with too many details, my object being to direct your attention to the half-time system, *i.e.*, half the time being devoted to mental and the other half to physical labour. At present, more for the convenience of the labour-master than anything else, the half-time system is only partly carried out; the proper method would be, half the day—say, the morning being occupied by teaching, the afternoon in handiwork of some kind. Three alternate days are given to the schools and the other three to agricultural labour, or trade, the position in each week being reversed.

After a trial, during the last seven years, it has been found that since physical and gymnastic exercises have been introduced, not only has the health of the children been improved, but better order and discipline have been maintained in the school and dormitories, and their physique has been materially improved by it. As an instance of this, some boys were required for the training ship, "Excellent," and the lads being asked to volunteer, sixteen or seventeen stepped out from the ranks. Of these none were rejected by the medical authorities, their chests being all of the proper standard size, whilst of a similar batch of boys drawn from another school of the same class more than half were rejected. In the last twelve months there have only been two deaths out of 800 children: one of these was a boy who died five or six weeks after admission, from old lung disease; the other was a child who, having been deserted and left exposed all night on Wandsworth Common, had never recovered the shock to the system induced thereby. The ordinary mortality does not exceed three per 1000.

You may fairly ask—what is the object of telling us all about these schools and their inmates? Well, it is this:—A large proportion of you are parents, and I wish to draw your attention to the necessity for not cramming your children with too much book-learning, but by adopting the old maxim, "A sound mind in a sound body," to let them have more play and more bodily exercise. We find in a school such as this, where children are drawn from the lowest order of society, exposed to the risk of frequent interruption to their education (for unless they are orphans, if the parents leave the workhouse in which they are temporarily residing, they are compelled to take their children with them), that the children here are equal to others attending a School Board school, whilst of the one-third of the number in this establishment, which is the proportion of children who are stationary, they excel the School Board children by the age of eleven or twelve. All these data are worthy of note, and I should like teachers in private schools and parents generally to notice them, because I am satisfied that as a rule sufficient attention is not paid to bodily training and exercise, more especially with girls. Why should not girls play (as at Anerley) not only with their hoops and skipping-ropes, but football (of course this only means kicking the ball about), trap-bat and ball, cricket, &c., in addition to the dumb-bell and manual exercises, which are rendered pleasant by the accompaniment of music and singing.

We may now leave Anerley, and study girls of our own social standing. Take, for instance, those who are just leaving school, or, as it is erroneously termed, "*finished their education.*" What exercise or physical exertion do they take in the course of the day? A short walk or lounge of an hour's duration in a town, looking at the shops. Why should not these young ladies take more physical exercise? It is too much the fashion for such as these to lead a purely artificial life; "they toil not neither do they spin." Their minds either become a blank, or lose much of that intellectuality which is so pleasant and yet so rare a feature in the young.

Why is this? Because their very existence is at war with time

and nature. One day is pretty much the same as the other: the same listless promenade, the same feeling of *ennui*, the same longing for bedtime, that another day has passed.

Given the disease—point out the remedy. I would urge upon all girls that as soon as they leave school they should take more physical exertion. This may be done in two ways:—

First. By cultivating some of those sciences which would teach them to look "through Nature up to Nature's God."

What can be a more feminine occupation than the study of Botany.

Cowper says: "The love of nature, 'tis an ingredient in the compound man, infused at the creation of his kind." What more exquisite in their simplicity than the wild flowers which are to be found in every hedge-row or country lane. The choicest exotics, cultivated at a larger cost and with great skill and care (themselves growing wild in tropical regions), can do no more than compare favourably with the simple posy gathered in an afternoon's ramble

Geology in its elementary form is well worth more study than is given to it. How many young people, and older ones too, who have strolled to our beautiful hills at Addington, and seeing the bed of smooth water-worn pebbles scattered over the surface, have ever given themselves the trouble to think, "Why are these here? How came they here?" and have drawn an analogy between them and the shingles on the sea-shore! Yet these pebbles at one time formed the shore of an ancient sea, precisely as at the present day at Brighton and elsewhere. They then became the estuary of some tidal river. This you can see by the fossil oysters found amongst them, which were just as now, living and dying on the spot.

All this is good mental food, and conjoined, as it must be, with bodily exercise, is one source, among others, which leads to "Health out of Doors."

Another, or second method, would be gymnastic or bodily exertion, combined with amusement.

What are those which are available for girls?

In later years it has been much more the fashion than formerly for girls to skate, but our winters are so variable and safe ponds so few, that the opportunity seldom arises for it to be frequently enjoyed. In summer there is lawn-tennis, but every one has not the privilege of a garden sufficiently large attached to their house. In every town in the kingdom of the size of this, or even smaller, I would establish a gymnasium, with a court attached suitable for rackets, fives, or lawn-tennis, which, I am told, is a beautiful game on a skating-rink surface. It should be opened during the day for ladies *only*, the evening being given to the sterner sex. I know medically that such a thing is urgently needed. All fancy work undertaken by ladies is an in-door occupation, and often necessitates a cramped position in the worker. When girls found that they could enjoy themselves in some out-door game freely, without any overlookers or fault-finders to say this or that was unladylike, or some nonsense of that kind, they would speedily become absorbed in the game—and what would be the after result? Muscles would be

brought into play which no amount of crewel, embroidery, or other work could develop; their chests would be expanded; the mind being engrossed with the interest taken in the game, the body would as a necessity get fatigued, any vain or unbecoming thoughts driven away, and thus a healthy moral tone imparted.

There need be no apprehension of any young girl becoming too forward or hoydenish, for the reason she would be in the society of her own sex, and a time would come sufficiently soon when she would not care to join in amusements which a year or two previously she was only too happy to participate in.

The Skating Rink where a portion of our Sanitary Exhibition is being held is for sale. Can we not purchase it, form a Limited Company, and adapt it to such a purpose as I have named? The object should not be excessive pecuniary gain, but it might be made not only self-supporting, but pay a small dividend, so that capital should not be felt to be either thrown away or unemployed. By being thrown open (more especially as a Gymnasium) to young men in the evening, they in their turn would be provided with healthy recreation when they return from business—a far more profitable occupation than lounging in our thoroughfares, smoking to excess, or making bad acquaintances.

I have shown, I hope, clearly what is accomplished by physical education at the North Surrey District Schools, and I have ventured to hint how much might be effected in the same direction with another class of pupils. Remember the paramount importance it is that the young, who will one day be the parents of a future generation, should be healthy now. It behoves us all, therefore, not only to advocate but practically to assist in carrying out the work; and if we are to become the long-lived people which our President predicted in his inaugural address we might be, we must not wait for the 200 years, but make a beginning at once, and then carrying on our imagination some twenty years, picture ourselves pointing with pride and congratulation, not only to 1879 as the year of the Sanitary Congress, when important and vital facts were first revealed to us, but turning to our grandchildren, congratulate ourselves on the improvement which has been secured in their mental and bodily culture, by which they have been fitted morally and socially for every station in life in which it shall please God to call them.

J. H. Strong, M.D.

On the Technical work of the Sanitary Institute of Great Britain.

Two important questions naturally suggest themselves; one at the opening, and the other at the close, of a Congress, like that in which we have been engaged. Previous to the opening of the Congress, everyone was inquiring as to the character of the work to be done. At the close of it, the critics are busily discussing

what has been, or is likely to be, the outcome of it. The character of the work done is now a matter of history, and I shall leave to others the task of analyzing and passing judgment upon the various matters brought forward and discussed at the Congress. In the few remarks which I have been invited to make upon the Congress, I shall confine myself to a brief consideration of its relation to the more technical work of the Institute, and give a short sketch of the principles upon which the Institute was founded.

The holding of a Congress, although a very useful method of bringing the work of the Institute into contact with public opinion, is not by any means essential to its existence. Should the Council at any time decide to suspend the Congresses altogether, or to hold them at longer intervals, it would not be the slightest indication that the work and usefulness of the Institute was on the wane. On the contrary, it would rather go to show that the technical work of examining and teaching which it has initiated was absorbing all its energy and force.

If the holding of Congresses formed no part of the *raison d'être* of the Institute, at its foundation, some who have recently become acquainted with it may be interested to know what is the technical work to which reference has been made, and the means by which it is carried out.

The pursuit of Sanitary Science required for its development that some organization should be supplied as a focus to which the members of the various professions engaged therein might be attracted. It was necessary that such an organization should embrace the makers and administrators of the laws relating to Public Health, and also the members of the various trades engaged in the manufacture of Sanitary appliances, and in carrying out the plans and designs of the scientific experts. These several sections are all represented in the three orders of Fellows, Members, and Associates, of which the Institute is composed, and which constitute, if I may so designate it, the corporation *in posse.* Life and Annual Subscribers are entitled to be enrolled and enjoy certain privileges, but take no part in the government or management of the Institute. Such in a few words is the "Basis of the Constitution."

The technical work which the Institute has set itself to perform, may be classed under the two following heads—

First.—The Council have appointed a Board of Examiners to conduct examinations, and to grant Certificates in Sanitary Science to Local Surveyors and Inspectors of Nuisances, and to persons desirous of qualifying themselves for such appointments, or of obtaining the Certificate of the Institute.

Second.—The Council appoint Judges to investigate Sanitary appliances, to award medals and certificates, and to carry out detailed experiments, by means of deferred practical trials, as to the value of the various forms of apparatus and appliances, which the public are invited to purchase, but the value of which they have few means of ascertaining beforehand.

The means by which the Council propose to carry out these important functions are also of a twofold character.

(*a*.) By the formation of a School of Hygiene for the technical teaching of Sanitary Science. The subjects to be taught in the School will embrace Preventive Medicine, Practical Sanitary Science (Medical, Chemical, Engineering, and Constructive), together with Jurisprudence and Sanitary Law. A systematic course of lectures will be delivered on each subject, and it affords a happy omen of success that Dr. Richardson, Professor Corfield, Captain Douglas Galton, and Mr. W. H. Michael have undertaken to deliver the first series of such lectures.

(*b*.) By holding an Annual Exhibition of Sanitary Apparatus and Appliances, by which means the immense importance of exemplifying the application of Art to Sanitation is fully realized, invention and excellence of workmanship are stimulated, and all classes of the public are instructed by seeing and examining the specimens for themselves.

The Institute aims, through its examinations, at pronouncing an authoritative opinion upon the fitness of those who may be called upon to carry out the provisions of the Public Health Acts. By carefully conducted tests it endeavours to determine the value of different kinds of appliances, and thereby to assist the public in forming a correct opinion upon the value of special means for alleviating the defects resulting from impure air, impure water, imperfect ventilation, and some of the grosser causes of the violation of the laws of health. Success in such a work as I have described, is only to be compassed by years of patient labour. It is, therefore, very encouraging to note that the results obtained by the Examinations and Exhibitions already held under the direction of the Council, give abundant evidence, not only of the usefulness, but also of the overwhelming importance of this portion of the work of the Institute.

The Institute would be strengthened, not so much by a Charter of Incorporation, as by the Government requiring that all those who are entrusted with carrying out the Public Health Acts should in future obtain a Certificate of Competence from some examining body previous to the confirmation of their appointments. Until this is done, Sanitary Authorities and Local Boards would greatly assist in the work of technical education if they were to require all their Local Surveyors and Inspectors of Nuisances to possess such a certificate, either at the time of their appointment or within a reasonable period afterwards.

Most of our Universities have instituted examinations and now grant certificates in Sanitary Science to medical men. It would be a great advantage and tend to secure uniformity of work and action on the part of Medical Officers of Health if they, in like manner, were required to possess a Certificate in Sanitary Science as a condition of their appointment.

It is admitted that Croydon has derived great advantages from Sanitary Science, in consequence of which, it is now the healthiest and wealthiest suburb of the metropolis. I sincerely hope and

believe that the Congress held here during the year 1879 will mark a period in the history and progress of Sanitary work, that it will serve as a finger-post to those who come after us, directing them to the attainment of a brighter, happier and healthier state of existence than even the favoured people of Croydon now enjoy. We may thus hope that the good effect of our work will leave its imprint "upon the sands of time."

Lory Marsh, m.d.

The Lessons Taught at the Exhibition.

I am requested to speak for a quarter of an hour upon the lessons which may be learnt from the Exhibition of Sanitary Appliances which has been opened in Park Lane in connection with this Congress.

The subject is a large one, the time for its consideration is limited, and the references must therefore be wide and general rather than detailed and specific.

I must divide my subject into several heads for convenience of reference.

First. The extent of the Exhibition. There is the broad fact that upwards of two hundred exhibits have been marshalled in the Central Croydon Station and its annexe—the Skating Rink; and that 189 distinct stands have been marked out for the exhibition of 710 different classes of articles. This work has been done at a considerable expense to those who have placed the articles there.

The list includes an immense number of things which at the first sight might, by a thoughtless objector, be considered outside the area of Sanitary work, and therefore foreign to the object which Sanitary Science has in view. This idea would arise from the narrow field to which the subject of Sanitary work is restricted in the minds of many people. It is, however, a fact that everything connected with the question as to how air is to be kept pure, good water provided, wholesome food procured, and healthy exercise obtained; how mental rest is to be ensured and artificial warmth acquired, comes properly within the consideration of those who are instructing the people in the mysteries of Sanitary law. The appliances connected with them and kindred arts are therefore fairly admissible into an Exhibition which is intended for the education of the people in the right principles of Sanitary work.

The expense which has been incurred by those who have made the Exhibition a success by becoming exhibitors, tells us most forcibly that a demand is springing up among the masses for a class of workmanship and a kind of material which shall be sanitarily perfect: and that persistent inquiries are being made by numerous individuals for such. It is a satisfactory sign of the times, and contains more in it than at first sight meets the eye of

the shallow observer. One great value of exhibitions such as ours in these matters exists in the fact that they bring all kinds of suggestions, all kinds of so-called Sanitary patents, to the test of trial by unprejudiced people, and the verdict of public opinion is fairly obtained. They give inventors an opportunity of seeing other inventions besides their own side by side with their own work. This enables all to judge of an individual work or of a competing invention better than could possibly be effected in any other way: and although every inventor will naturally be biassed in favour of his own invention, just as every mother thinks her own child the finest, the handsomest, or the best in the world; yet it naturally follows that the people, who are, after all, the judges, will pronounce an opinion upon the merits of an invention and give effect to their judgment by preferring the most useful article. By this means inventors have the weak points in their inventions quickly shown to them, and they learn lessons which may save them much loss of time, and prevent a needless expense. Although they may outwardly retain their opinions as to the superiority of their own work, they do not waste the further time and money that they might otherwise have done if they had not had an opportunity of testing rival plans. Thus both inventors and the public are mutually benefited by that close scrutiny which all such works receive at the hands of rival manufactures. Inventors of useless designs are shown their uselessness by the neglect which is accorded to them, and they are saved much expense which they would probably have been put to if they had not exhibited and if the comparison had not been made.

Second. The measures which had to be taken for the establishment of the Exhibition, and still more, the character of the Exhibition itself, bring out into strong prominence the fact that it is to men of science that humanity owes all beneficial progress, and that, although the masses of the people may deify the politician of the day, or the successful soldier, and may follow about the stump orator, or the cunning political place-seeker, as if they were made of a material something more than human, it is not to the ordinary politician that we must look for any improvement in the welfare of the people or for progress in arts and sciences. The politician is never so true a friend of the poor man as the man of science.

It was the man of science who developed mathematical precision, who elaborated architectural design, and gave employment for the building trades. It was the man of science who perfected our chemical works, and gave us manufacturing pre-eminence; who discovered the power of gas and steam; who traced out our railroads, made our steamboats, and projected our telegraph lines. It is science and not politics which developed every step of progress which has been made in lengthening man's life and diminishing the chances of, as well as the evils attendant upon, sickness and mortality. Politicians have added to these evils to a fearful extent by impeding the adoption of right measures and trafficking in gigantic jobs. It is science and not politics which has done all

that has been done to elevate the human race beyond that mediæval position which it occupied in the Middle Ages. At that time agriculture was the principal occupation of the masses, and the people were to some extent the serfs of the great landowners.

It is science, not politics, which will do away with war, abolish standing armies, and make men beat their swords into ploughshares and their spears into pruning-hooks. It will not be very long before war will be of that deadly character that it will become an impossible act between civilized nations: because the arms of precision will be so fatally constructed that both the contending armies will be all but annihilated in the struggle; whilst on the sea the weapons of warfare will be almost as dangerous to friends as to enemies.

In the meantime, science is showing us that our life is far shorter than it ought to be, that disease is an unnecessary adjunct to our state of existence, and that a doctor's duty would be more effectually exercised in keeping people well than in curing them after illnesses have commenced.

The man of science is often abused by the stump orator, or sneered at by the narrow-minded politician. He is deserted for the platform of the latter, and left to fight his own battles all but single-handed: but after all, science and not politics is the true friend of the people. If our Exhibition had had a political tendency, it would have met with an enthusiastic reception by one or other side of the great camps into which the country is divided. Its establishment was outside the pale of political life, and politicians gave us very scanty help. I hope our thinking population will take this to heart, and not be led away by clap-trap and clamour to neglect the teachings of art and science, and the study of those natural laws upon which the happiness and prosperity of the people depends.

No unprejudiced person can walk through the Exhibition which is just now closing without seeing on all sides of him that comfort and happiness, personal enjoyment, and personal safety are to be found in industrial works rather than in the useless platitudes of political warfare. I am urged to make these remarks because acknowledged politicians are seldom willing to help forward Sanitary measures until the people themselves have determined that such works shall be done. I am satisfied, therefore, that it is our duty, as having a perfect trust in the rectitude of our principles, that we must educate the public in those principles before politicians will deign to help us in the least. Expediency will then bring them into our camp.

The next point which has been brought out by the Exhibition in Park Lane is the fact that there are wonderful provisions for the protection of the people against the incidences of those diseases which vice, folly, and avarice have brought among us, and concerning which both as to cause and cure the great majority of the people are at present profoundly ignorant. It has been said that the people of Croydon as a whole were well up in the study of Sanitary work, and had such perfect knowledge as to the right use

of Sanitary appliances that as far as they were locally concerned, the Exhibition would be a work of supererogation. I hope those self-satisfied individuals will now acknowledge their error: no one can remain for long within the precincts of the tent without observing something to interest him as making life more enjoyable, something to be made a note of.

It has been a great pleasure to me to watch the intelligent mechanic looking closely into things which had not caught my eye, to observe that he took in at a glance that which would have taken me a long time to comprehend, and to make an observation which told me that the plumber—for such was his trade—had learned something which he did not know before. Had it been possible to have held the Exhibition in Croydon ten years ago, we should most probably have escaped the evils which arose in 1875 from a general want of knowledge upon the proper principles which should guide the householder in his plumbing and house-draining work.

The absence of correct knowledge on these points led to the greatest misfortune which has ever befallen our town. It brought its lesson, which it is to be hoped will never be forgotten. Be that as it may, the exhibition of appliances connected with the supply of water to houses and its use for cleansing purposes is such as must make our local workmen as efficient as it is possible for any body of men to be, if they have taken advantage of the opportunities afforded to them. I wish it could have been arranged that all men so employed could have had an opportunity afforded them of visiting the Exhibition at a set time, and having the principal exhibits explained to them by Captain Galton and Professor Corfield; such demonstrations on the spot by such men would be a right work for the Sanitary Institute to entertain. The gimcrack appliances which are now in use in this town for the purpose of checking the waste of water ought to be abolished by universal consent, and the efficient apparatus which were exhibited by more than one firm substituted in their stead. It will be a lasting shame to our intelligence if any difficulty is again experienced in Croydon either in preventing useless waste of water, in making its contamination impossible, or in staying the intrusion of foul air from the sewers into the interior of our houses. All these results are shown to be easy of attainment. It would be invidious on my part to mention the names of makers; I must refrain therefore for fear of doing an injury to an equally efficient plan. No one, however, can examine the works of art submitted by Doulton, and Stiff, by Jennings, and by Wilcox of Leeds, without being struck by the advance which has been made in Sanitary work since the days when common earthenware pipes were first laid in Croydon. The beautiful and efficient appliances which are now produced enable us to command a non-porous material for our butchers' and fishmongers' shops; to protect our hospitals and our bath-rooms from the evils of contamination; our kitchens and our larders from absorptions of foul matter, and save us from many hitherto unsuspected dangers. The exhibition of such works must indicate the

fact of a real evil which it behoves all those that are engaged in such occupations and businesses to have reduced to a minimum. I must refer to the impervious pipes which are made of material capable of repair, and which are shown of enormous size. They are far superior to bricks for sewers, and if, as reported, they resist the chemical influences of sewage, they are invaluable for sewer purposes, and such concrete tubes should be used wherever possible.

I must mention the exhibit of Mr. Lascelles, because he is a Croydon man, and because he has manufactured, out of that which was supposed to be a useless material, a most valuable article, whilst the substance of it is such as will enable those who occupy the buildings which he erects to defy fire, and, what is of much greater importance, to defy the chance of infectious disease becoming a part and parcel of the building. The germs which can be produced may be manufactured, so to speak, in the rafters, the floors, and walls of the infected building. Such infection is not possible in Mr. Lascelles' work, and I trust that his public spirit in showing it at Croydon may meet with a proper reward.

The next point of general importance in this Exhibition are the various plans shown to obtain a good ventilation of buildings. They indicate a necessity, and show us that there are many men prepared to remove the evil which a want of ventilation entails. I fear that for ordinary dwellings there will be a difficulty in fixing upon the best plan, if it is necessary to be independent of open windows and well-constructed fireplaces; of which some most excellent and ingenious specimens were to be seen.

I must not omit to mention the advance which has been made in the use of gas for cooking and other household purposes. The use of gas for such purposes may reconcile us to the low illuminating power which gas companies find it most beneficial to themselves to supply. A low illuminating power is better fitted for heating purposes than a higher one, and those who use gas for fires and cooking may well be content with a low lighting power. The information conveyed by the Exhibition, as to the best plan for cooking and for warming purposes, must be generally useful, and ought to give a great impetus to its more general use in private houses. It is cleaner, it is safe, and, if carefully husbanded, it is shown to be nearly as cheap as house coal, whilst it saves much labour and great waste. But it requires a proper regulation as to ventilation, and a right application of vapour to render it satisfactory. All these were met by several appliances which were exhibited in the building. The economical housewife could not have spent a morning in the Exhibition, examining these appliances, without making up her mind to introduce them into her own kitchen; whilst to the poor, who have to husband their coal for cooking purposes, they would be a priceless benefit, if it was not for the first expense of laying on the gas.

The transition from gas to cooking is natural. The cooking stoves, which enabled cooks to do their work as efficiently with much less fuel than is ordinarily used—whilst the heat of the kitchen at times is all but unbearable,—is a manifest improvement.

As regards sewage utilization, there was not much scope for show; but in those districts into which sewers are not yet introduced, and where they are certainly objectionable, the earth-closets, such as Moser's and other makers', show an advance upon the objectionable cesspool, and should indicate to Sanitary authorities that to allow of the latter is a blunder and a crime.

The exhibition of school furniture is an indication of a growing knowledge as to the evils which are induced in school by bad position and muscular restraint. This subject requires more attention than it receives, and if time allowed I should dwell strongly upon the point. If time was not failing me, I must, however, refer to one more sign of the times: it is the care which is now bestowed upon the production of non-intoxicating drinks. Our townsman, Mr. Packham, is doing good service, and his pure waters and such drinks as zoedone and all the class are likely to help the cause of temperance among us, and to assist in removing the greatest cause of disease and early death which exists among us. May Sanitarians never forget that this is one of their missions, as well as the production of appliances for providing pure air, pure water, and wholesome food. I will conclude with the words—May God prosper the work. *Finis coronat opus.*

ALFRED CARPENTER, M.D.

Professor CORFIELD then delivered an interesting address entitled "Mistakes about Health," which was frequently applauded. Through an oversight the Editors regret they are unable to publish it in the Transactions for the present Year.

The following Letter, written to the President of the Congress of the Sanitary Institute of Great Britain, Croydon, was also read.

DEAR AND HONOURED PRESIDENT—

Will you express my regret at the conditions which prevent my attendance to fulfil the task you have assigned to me of briefly addressing the meeting on the application of Sanitary Science to the reduction of Infantile Mortality prevalent amongst the wage classes in Croydon?

With all shortcomings, the result of ignorant opposition, a reduction of the death-rates of the general population by more than one-third in Croydon, as compared with the death-rates previous to the introduction of works on Sanitary principles, must be a consolation to those who have bestowed their labour on their prosecution. But a table which I have had made out, showing

the mortality and its chief preventable causes amongst the more numerous classes of society, shows, as respects the labouring classes there, that there is yet a greater amount of insanitary conditions to be removed, especially affecting their children, than I had anticipated. It appears from this return that whilst of the children of the gentry and professional persons, 6·41 per cent. die within their first year—and 9·26 within their fifth year of life;—of the wage classes, 22·63 die within their first year of life, and 39·03 within their fifth year. This excessive death-rate of the children of the wage classes, I submit demands a close examination of the causes. It appears from the returns that a greater proportion of the excess arises from zymotic and other diseases which we know to be removable. Such excess, I can state, does not affect wage classes in rural districts, where the proportion of deaths in the infantile stages is not greater than those of children of the best-conditioned classes of Croydon.

On the visit we made the other day to the Orphan Institution—the district school—near here at Anerley—we saw Sanitary conditions, by which the great mass of children's diseases that produce the high death-rates amongst the children of the wage classes in Croydon are now almost entirely prevented. If such an amount of infantile mortality prevailed amongst the pauper children in that Institution, as the returns show to be yet prevalent in Croydon amongst the children of the industrious and self-supporting wage classes, it would be deemed intolerable, and would properly be made the subject of a public inquiry.

Now, without imputing any blame to anyone, except an ignorance of Sanitary Science, and as a consequence, want of skill in its application; do you not consider that a special voluntary inquiry into the causes of these excessive infantile death-rates may be commended to the people of Croydon, in which I am sure we should be glad to render them any aid in our power?

I must, however, guard myself against any supposition that I consider that such means of prevention as we saw in operation at Anerley; such sleeping space, such bedding for the children, each in a separate bed,—with such air-cleanliness, such skin- and clothes-cleanliness, such wall-cleanliness, such ventilation, such physical exercises, such tepid baths,—could be immediately obtained and practically applied, without a great mind and a mighty effort, for the protection of the children of the wage classes at Croydon. Nevertheless, with the light of existing experiences, it may be shown that a great deal more may be accomplished on principle in the way of prevention than will readily be recognized. For the prevention of disease, as for the prevention of fire, immediate action must be taken upon the first spark. By organized inspections, and action upon the earliest premonitory symptoms, we, at the first General Board of Health, reduced death-rates from cholera by three-fourths.

I need not describe the conditions of large proportions of the mothers of the children of the working classes—of how much those mothers have to do without help, in order to cook their

husband's meals as well as those of their children; how often they have to leave their rooms for the whole day—how many of them have to go out to work during the day without having any one competent to "mind baby" and the children. Do people know the fact, as stated by Dr. Farr in his statistics, that in this country of ours some fifteen hundred children are annually burned alive, chiefly from accidents due to their clothes catching fire when left alone during the mothers' absences? You best know and can best describe the common ignorance of poor mothers of the means of preventing the generation and the spread of fatal disease amongst their children. Such conditions are now mitigated by the institution of well-appointed *crèches*, the use of which is extending at Paris and in other cities on the Continent, and also in America. The poor mother has no nurse, and no governess to help her in the care of her children, and no doctor to visit them, as the rich mother has. But the institution of the *crèche* gives to the poor mother, for a time, a sufficient share of the services of both. When she is obliged to go out for work, or to attend to other matters at home, she places her infant for the time under the care of a nurse, at a convenient and well-appointed place, the *crèche*, and returns at a proper time to give it suck. For those children who are weaned, food is provided, better than it is usually done at the cottage, and at no greater cost. The nurse of the *crèche* takes care that the infants are brought and kept in a constant state of cleanliness. A doctor visits the *crèche* every day and examines each of the children. If he detects any incipient symptoms of disease, he orders the immediate separation of the child, and goes to the home and gives instructions as to the treatment of the case; and if it be a case of infectious disease, gives instructions for the prevention of the spread of the infection. If he finds about the house any local cause, for the generation or the aggravation of disease, he takes order for the removal of that cause. This may be made a great factor of prevention.

The results of the well working of these institutions are such as you would confidently expect them to be. We were assured at the last International Congress on Hygiene, held at Brussels, that they had effected a reduction of one-half—one-half, be it remembered! —of the previous infantile death-rates. At first, the unguarded agglomeration of infants in their dirty conditions, as in all our common schools, caused the *crèches* to be unsuccessful; but now they, the children, are required to be carefully and agreeably cleansed with tepid water. These institutions are spreading in America; and a visitor of one in New York gives a description of the outdoor children, as presenting the same agreeable appearance as was presented to us by the indoor infants on our visit to the Institution at Anerley. "There," he says, "we found engaged with toys a number of tiny trotters, all clean as new pins, and all fresh from the bath. Those who send their children to the *crèche* are working women, who pay, and without the help of this nursery would have to pay, for having the child looked after at home, or else lose their daily employment. Besides this, there are few

homes, especially in a city, where little children could have the benefit of such good air, such cleanliness and good food as in this admirably managed establishment. What happiness and ease of mind for the working mother to feel that her infant is safe and not left to the tender mercies of the dram-drinking virago, whose control over the child left to her care lies in threats and starvation!"

The next means for the prevention of infantile sickness and mortality is a well-appointed infant-school, under similar conditions as to cleanliness, and with the service of a regular examination by a responsible medical officer of health on alternate days, and with the exercise of the power and duty of similar action on the detection of symptoms of incipient disease. Next after that comes the primary school on the half-time principle, with a visit and examination of every child by a competent medical officer at least once every week, and with immediate separation and prompt preventive action upon the earliest symptoms of disease. In the infant-school and the so-called primary school (the real primary school, the most "formative" upon a proper national system being, as I have elsewhere shown, the infant-school) there should be provided such physical training by exercises of all sorts, as is seen at Anerley, which would serve as a college for the guidance of the preventive training of a whole district. Such exercises, you well know, and as Dr. Roth has long shown, serve to correct and eradicate congenital defects and hereditary lameness, as well as to fortify the body against the common passing causes of disease.

Such physical exercises, it may be observed, serve as training in morality, in action, in patience, in self-restraint, and in prompt and immediate obedience to command. Let not the working-man imagine that the military drill, which is one of them, serves only to fit his son to be a soldier. It trains his son to be a better and more valuable workman, and to be worth more wages than the untrained stupid, slow, and clumsy common lout. It exercises his sons in collective action in lifting together, in pulling together for the increase of force, so important in these days, in prompt and exact results. Such training as that at Anerley,—such as might be and ought to be given in all public elementary education,—imparts to two the efficiency and value of three for productive industry. It teaches the child in walking to move more quickly from point to point. He will by treading more evenly, as experience shows, save a pair of boots a year as long as he lives. In enforcing personal cleanliness, be it noted, we are enforcing an important economy of food. It is found that pigs that are washed put on a fifth more flesh with the same amount of food consumed than do pigs that are unwashed; and so it is with human beings. Five children that are washed will do as well on the same amount of food as that which is required by four that are unwashed. The medical officer's visits to the homes may have the important effect of correcting defective house work; and, on the whole, though we may not obtain such great results as are attained at Anerley, a considerable advance will be made towards the reduction of infantile mortality by the arrangements I have specified.

But, say the local rate expenders, will not all this incur great expense? No, we reply, great economy! As I stated on Saturday, the cost of teaching and training at Anerley is little more than a pound per head per annum, for physical training as well as book teaching on the half-time principle; or less than one-half the cost of the inferior mental training given in the common small long-time schools. The children taught in the good infant schools at Anerley, complete their instruction in the three R's in five years, as against seven in the long-time schools; that is to say, the cost of well organized half-time is £1 per head for five years, as against more than £2 per head for seven years. In other words, the cost of teaching and training well, physically and mentally, three children on the one system, may be set against the cost of teaching one child comparatively ill on the other.

I must repeat that the common long-time schools, in occupying the children with the three R's up to the thirteenth year, practically exclude from secondary education even those of middle-class parents who cannot afford to keep their children at school beyond that period; while such an organization as that at Anerley, which, with the aid of good infant-school teaching, completes the instruction in the three R's two years earlier, gives the time needed for secondary education, and with that time gives more of physical and industrial training to fortify the constitution in health and strength for work through life. There is moreover the gain in the domestic budget by combining earning with learning on the half-time principle.

All this Sanitary improvement, conditioning mental and moral improvement, and augmentation of health and strength and productive power, is practicable on the principles of administration of the half-time school you visited. We challenge the existing systems as weakening the body to strengthen the mind, which they comparatively fail to do;—and we claim a foremost position for Sanitary science, in the national training and education of the population.

I have the honour to be,

Dear and honoured President,

Your faithful Servant,

EDWIN CHADWICK.

To DR. B. RICHARDSON, *President of Congress.*

At the conclusion, the PRESIDENT called for a vote of thanks to the gentlemen who had addressed the meeting, and this was awarded by acclamation. A vote of thanks was then, on the motion of SIR ANTONIO BRADY, unanimously accorded to the PRESIDENT for his kindness in presiding, after which the meeting separated.

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Sanitary Institute of Great Britain.

THE CALENDAR

FOR THE YEAR

1880.

LONDON:
PUBLISHED BY AUTHORITY OF THE COUNCIL.

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JANUARY.

1	Th.	
2	F.	
3	S.	
4	**S.**	Second Sunday after Christmas Sir Isaac Newton [born, 1642
5	M.	
6	T.	Epiphany
7	W.	
8	Th.	
9	F.	
10	S.	
11	**S.**	First Sunday after Epiphany
12	M.	Hilary Law Term begins
13	T.	Cambridge Lent Term begins
14	W.	Oxford Lent Term begins
15	Th.	
16	F.	
17	S.	
18	**S.**	Second Sunday after Epiphany
19	M.	
20	T.	
21	W.	
22	Th.	Last day for giving Notice of Examination
23	F.	Council Meeting, Sanitary Institute
24	S.	
25	**S.**	Septuagesima Sunday
26	M.	
27	T.	
28	W.	
29	Th.	Last day to pay fee for Examination
30	F.	
31	S.	Hilary Law Term ends

FEBRUARY.

1	**S.**	Sexagesima Sunday
2	M.	
3	T.	
4	W.	Exam. Surveyors and Inspectors of Nuisances
5	Th.	
6	F.	
7	S.	
8	**S.**	Quinquagesima Sunday
9	M.	
10	T.	Shrove Tuesday. Queen Victoria married, 1840
11	W.	Ash Wednesday
12	Th.	
13	F.	
14	S.	
15	**S.**	First Sunday in Lent
16	M.	
17	T.	
18	W.	
19	Th.	
20	F.	
21	S.	
22	**S.**	Second Sunday in Lent
23	M.	
24	T.	
25	W.	
26	Th.	Council Meeting Sanitary Institute
27	F.	Thames Angling ends
28	S.	
29	**S.**	Third Sunday in Lent

MARCH.

1	M.	
2	T.	
3	W.	
4	Th.	
5	F.	
6	S.	
7	**S.**	Fourth Sunday in Lent
8	M.	
9	T.	
10	W.	Sir William Fergusson died, 1877
11	Th.	
12	F.	
13	S.	
14	**S.**	Fifth Sunday in Lent
15	M.	Dr. Parkes died, 1876
16	T.	
17	W.	
18	Th.	Princess Louise born, 1848
19	F.	Cambridge Lent Term ends
20	S.	Oxford Lent Term ends Sir Isaac Newton [died, 1726
21	**S.**	Palm Sunday
22	M.	
23	T.	
24	W.	Hilary Law Sittings end
25	Th.	Council Meeting, Sanitary Institute. Lady Day
26	F.	Good Friday
27	S.	
28	**S.**	Easter Sunday
29	M.	Bank Holiday.
30	T.	
31	W.	

APRIL.

1	Th.	
2	F.	Census of United Kingdom taken, 1871
3	S.	
4	**S.**	Low Sunday
5	M.	
6	T.	Easter Law Sittings begin
7	W.	Prince Leopold born, 1853
8	Th.	
9	F.	
10	S.	
11	**S.**	Second Sunday after Easter
12	M.	
13	T.	
14	W.	Princess Beatrice born, 1857
15	Th.	
16	F.	
17	S.	
18	**S.**	Third Sunday after Easter. Abernethy died, 1831
19	M.	
20	T.	
21	W.	
22	Th.	Council Meeting, Sanitary Institute
23	F.	
24	S.	
25	**S.**	Fourth Sunday after Easter Princess Alice [born, 1843
26	M.	
27	T.	
28	W.	
29	Th.	
30	F.	London University founded, 1827

MAY.

1	S.	Duke of Connaught born, 1850
2	**S.**	Fifth Sunday after Easter
3	M.	
4	T.	
5	W.	
6	Th.	Ascension Day
7	F.	
8	S.	
9	**S.**	Sunday after Ascension Day
10	M.	Half-Quarter Day
11	T.	
12	W.	
13	Th.	Vaccination introduced, 1796
14	F.	Oxford Term ends. Easter Law Term ends
15	S.	Oxford Trinity Term begins
16	**S.**	Whit-Sunday
17	M.	Bank Holiday. Last day for giving Notice of [Examination
18	T.	
19	W.	
20	Th.	Council Meeting, Sanitary Institute
21	F.	
22	S.	
23	**S.**	Trinity Sunday
24	M.	Queen Victoria born, 1819
25	T.	Trinity Law Term begins. Princess Helena [b. 1846
26	W.	Last day to pay fee for Examination
27	Th.	
28	F.	
29	S.	
30	**S.**	First Sunday after Trinity
31	M.	

JUNE.

1	T.	Examination Surveyors and Inspectors of [Nuisances
2	W.	
3	Th.	
4	F.	
5	S.	
6	**S.**	Second Sunday after Trinity
7	M.	
8	T.	
9	W.	
10	Th.	
11	F.	
12	S.	
13	**S.**	Third Sunday after Trinity
14	M.	
15	T.	
16	W.	
17	Th.	
18	F.	
19	S.	
20	**S.**	Fourth Sunday after Trinity. Queen's Accession, [1837
21	M.	Longest Day
22	T.	
23	W.	
24	Th.	Midsummer Day. Council Meeting, Sanitary [Institute
25	F.	Cambridge Term ends
26	S.	
27	**S.**	Fifth Sunday after Trinity
28	M.	Coronation of Queen Victoria, 1838
29	T.	
30	W.	

JULY.

1	Th.	
2	F.	
3	S.	
4	**S.**	Sixth Sunday after Trinity
5	M.	
6	T.	
7	W.	
8	Th.	
9	F.	
10	S.	Oxford Trinity Term ends
11	**S.**	Seventh Sunday after Trinity
12	M.	Meeting to form Sanitary Institute, 1876
13	T.	
14	W.	
15	Th.	
16	F.	
17	S.	
18	**S.**	Eighth Sunday after Trinity
19	M.	
20	T.	
21	W.	
22	Th.	Council Meeting, Sanitary Institute
23	F.	
24	S.	
25	**S.**	Ninth Sunday after Trinity
26	M.	
27	T.	
28	W.	
29	Th.	
30	F.	
31	S.	

AUGUST.

1	**S.**	Tenth Sunday after Trinity. Congrès d'Hyg. [opened at Paris, 1878
2	M.	Bank Holiday
3	T.	
4	W.	
5	Th.	
6	F.	Duke of Edinburgh born, 1844
7	S.	Trinity Law Sittings end
8	**S.**	Eleventh Sunday after Trinity
9	M.	
10	T.	
11	W.	
12	Th.	Grouse Shooting begins
13	F.	
14	S.	
15	**S.**	Twelfth Sunday after Trinity
16	M.	Gas first introduced in London, 1807
17	T.	
18	W.	
19	Th.	
20	F.	
21	S.	
22	**S.**	Thirteenth Sunday after Trinity
23	M.	
24	T.	
25	W.	Professor Faraday died, 1867
26	Th.	
27	F.	
28	S.	
29	**S.**	Fourteenth Sunday after Trinity
30	M.	
31	T.	

SEPTEMBER.

1	W.	Partridge Shooting begins
2	Th.	
3	F.	
4	S.	
5	**S.**	Fifteenth Sunday after Trinity
6	M.	
7	T.	
8	W.	
9	Th.	
10	F.	
11	S.	
12	**S.**	Sixteenth Sunday after Trinity
13	M.	
14	T.	
15	W.	
16	Th.	
17	F.	
18	S.	
19	**S.**	Seventeenth Sunday after Trinity
20	M.	
21	T.	
22	W.	
23	Th.	
24	F.	
25	S.	
26	**S.**	Eighteenth Sunday after Trinity
27	M.	
28	T.	
29	W.	Michaelmas Day
30	Th.	

OCTOBER.

1	F.	Cambridge Michaelmas Term begins
2	S.	Congress and Exhibition opened at Stafford, 1878
3	**S.**	Nineteenth Sunday after Trinity. Congress [and Exhibition opened at Leamington, 1877
4	M.	
5	T.	
6	W.	
7	Th.	
8	F.	
9	S.	
10	**S.**	Twentieth Sunday after Trinity
11	M.	Old Michaelmas Day. Oxford Michaelmas Term [begins
12	T.	
13	W.	
14	Th.	Severe Storm at Leamington, 1877
15	F.	
16	S.	
17	**S.**	Twenty-first Sunday after Trinity
18	M.	
19	T.	
20	W.	
21	Th.	Congress and Exhibition opened at Croydon, 1879. [Last day for giving Notice of Examination. [Meeting Council Sanitary Institute.
22	F.	
23	S,	
24	**S.**	Twenty-second Sunday after Trinity
25	M.	Dr, Rumsey died, 1876
26	T.	
27	W.	
28	Th.	Last day to pay Fees for Examination
29	F.	
30	S.	
31	**S.**	Twenty-third Sunday after Trinity

NOVEMBER.

1	M.	
2	T.	Michaelmas Law Term begins
3	W.	
4	Th.	Examination Surveyors and Inspectors of [Nuisances
5	F.	
6	S.	
7	**S.**	Twenty-fourth Sunday after Trinity
8	M.	
9	T.	Prince of Wales born, 1841
10	W.	
11	Th.	
12	F.	
13	S.	
14	**S.**	Twenty-fifth Sunday after Trinity
15	M.	
16	T.	
17	W.	
18	Th.	
19	F.	
20	S.	Suez Canal opened 1869
21	**S.**	Twenty-sixth Sunday after Trinity. Crown [Princess of Germany born, 1840.
22	M.	
23	T.	Michaelmas Law Term ends
24	W.	
25	Th.	Council Meeting, Sanitary Institute
26	F.	Election of First London School Board, 1870
27	S.	
28	**S.**	Advent Sunday
29	M.	
30	T.	St. Andrew. Royal Society Instituted, 1660

DECEMBER.

1	W.	Princess of Wales born, 1844
2	Th.	
3	F.	
4	S.	
5	**S.**	Second Sunday in Advent
6	M.	
7	T.	
8	W.	Plague of London began, 1665
9	Th.	
10	F.	
11	S.	
12	**S.**	Third Sunday in Advent. Prince Albert d. 1861. [Princess Alice d. 1878.
13	M.	
14	T.	
15	W.	
16	Th.	Cambridge Michaelmas Term ends
17	F.	Oxford Michaelmas Term ends
18	S.	Council Meeting, Sanitary Institute
19	**S.**	Fourth Sunday in Advent
20	M.	
21	T.	
22	W.	
23	Th.	
24	F.	
25	S.	Christmas Day
26	**S.**	First Sunday after Christmas
27	M.	Bank Holiday
28	T.	
29	W.	
30	Th.	
31	F.	

SANITARY INSTITUTE OF GREAT BRITAIN.

Formation of the Institute.

The increasing importance attached to Sanitary Science, and the recognized position it is assuming in the public mind, appeared to the promoters of the Sanitary Institute fully to justify the formation of a National Society, the object of which should be to devote itself *exclusively* to the advancement of all subjects bearing upon Public Health. In furtherance of the object, a meeting was held at St. James's Hall, on the 13th July, 1876, at which His Grace the Duke of Northumberland presided, when it was unanimously resolved :—

First—" That in the opinion of this meeting the Sanitary condition of this country is still very unsatisfactory and that further legislation is necessary with a view to its improvement; and that for the purpose of collecting and imparting information upon all matters connected with the subject of 'Public Health' a Society be now formed to be styled 'The Sanitary Institute of Great Britain.'"

Second—" That the gentlemen whose names are appended be requested to act as a Committee (with power to add to their number) for the purpose of carrying out the previous resolution and of reporting to an adjourned public meeting to be held during the second week in October next." *

The Committee appointed to report upon the subject considered it would add greatly to the usefulness of the Institute if Mayors of Boroughs, Chairmen of Local Boards, Sanitary Authorities, Medical Officers of Health, and all who have to administer the Public Health Acts, would associate themselves with the Institute, either in their individual or corporate capacity, and take part in its proceedings. By thus bringing their united knowledge and experience to bear upon Sanitary matters, the Laws relating to the same would become better known and be more efficiently administered.

* An adjourned public meeting was held on the 14th of March, 1877, when the report was unanimously adopted and a Council subsequently appointed to carry it into effect.

Basis of the Constitution of the Institute.

Section I.

Charter of Incorporation, Membership and Government of the Institute.

As soon as practicable a Charter of Incorporation shall be obtained, as it will facilitate some portions of the work of the Institute, more especially the Examinations as set forth in Section II. Until a Charter is obtained, the examinations shall be continued as heretofore, and a Register of persons certificated as competent to act as Local Surveyors and Inspectors of Nuisances shall be formed.

The Institute shall consist of Fellows, Members, Associates, and Subscribers.

Fellows shall be elected by ballot by the Council, and shall include scientific men of eminence, persons of distinction as Legislators or Administrators, and others, who have done noteworthy Sanitary work.

All Fellows (except those who have already become Life Members) shall pay a fee of Ten Guineas on taking up the Fellowship, and such fee shall entitle the Fellow to all the privileges and advantages of the Institute for life without further payment.

Any person proposed by five Fellows or Members, shall be eligible for election as a Member of the Institute.

Members shall be elected by ballot by the Council, and shall be eligible to serve on the Council, and to vote at all Elections and Meetings of the Institute. The Admission Fee payable by a Member shall be £3. 3*s*, and the Annual Subscription £2. 2*s*.

Medical Officers of Health and Medical Men holding Certificates in Sanitary Science from any University or Medical Corporation shall be entitled to be enrolled as Members of the Institute without Admission Fee.

Members desirous of becoming Life Members may do so on payment of £10. 10*s* in lieu of the Annual Subscription.

All persons who have passed the Examination and received the Certificate for Local Surveyor from the Institute, shall, by virtue of having so passed, become Members of the Institute upon the payment of Five Guineas (without Annual Subscription) in addition to the fee paid for the Examination and Certificate.

Any one proposed by two persons, either Fellows, Members, or Associates of the Institute, shall be eligible to be elected as an

Associate of the Institute, the election to be by ballot by the Council. The Admission Fee payable by Associates shall be Two Guineas, and the Annual Subscription One Guinea.

All persons who have passed the Examination and received the Certificate for Inspector of Nuisances from the Institute, shall, by virtue of having so passed, become Associates of the Institute upon the payment of Three Guineas (without Annual Subscription) in addition to the fee paid for the Examination and Certificate.

Persons of either sex, interested in the advancement of Sanitary Science, shall be entitled to be enrolled as Subscribers on payment of One Guinea annually. Annual Subscribers shall be entitled to attend and to take part in the discussions at all Meetings and Congresses of the Institute, and shall have free admission to the Conversaziones and Exhibitions of Sanitary Appliances held in connection with the Institute, so long as they continue to pay their Subscription.

Donors of Ten Guineas and upwards shall be entitled to be enrolled as "Life Subscribers," with all the privileges and advantages of Annual Subscribers without further payment.

Subscribers of Half-a-Guinea to any Congress of the Institute shall be entitled to a card of admission to the Meetings, Addresses, Conversazione, Excursions, and Exhibition held in connection with that Congress.

The Institute shall be governed by a President, Vice-Presidents, and a Council of Twenty-four, consisting of Fellows and Members of the Institute, of whom not less than two-thirds shall be Fellows. The Council shall be chosen by the Fellows, and Members. One-fourth of the Council shall retire annually, and shall not be eligible for re-election for one year.

The first President of the Institute shall be His Grace the Duke of Northumberland. Future Presidents and Vice-Presidents shall be elected by the Council. The Council shall have the power of electing Honorary Members of the Institute, Honorary Foreign Associates, and Corresponding Members of the Council.

Section II.

Objects of the Institute.

To devote itself to the advancement of Sanitary Science and the diffusion of knowledge relating thereto.

To examine and to grant Certificates of competence to Local Surveyors and Inspectors of Nuisances, and to persons desirous of becoming such or of obtaining the Certificate. The Examinations shall be held at such times and in such places as the Council may direct.

A Board of Examiners shall be appointed by the Council; such Board shall consist of gentlemen representing Medical, Chemical,

and Sanitary Science, Engineering, Architecture, and Sanitary Jurisprudence.

The Examination for Local Surveyors shall include a competent knowledge of the Statutes relating to Sanitary Authorities, of Sanitary Science and Construction, and of Engineering.

The Examination for Inspectors of Nuisances shall comprise the elements of Sanitary Science, together with Sanitary Construction, and the Statutes relating to the prevention of disease and the suppression of nuisances injurious to health.

Fees shall be charged for the Examinations and a certificate of competence, signed by the Examiners, shall be granted to successful candidates, entitling them to be designated as "Certificated by the Sanitary Institute of Great Britain."

The Institute shall take such steps as may be within its power to obtain a complete registration of sickness, especially of preventable diseases.

The Institute shall endeavour to secure the services of medical men and others specially qualified to give lectures on subjects relating to the prevention and spread of disease.

The Institute shall encourage the formation of classes for technical instruction in Sanitary Science in such a way as may seem advisable to the Council.

Exhibitions of Sanitary Apparatus and Appliances shall be held from time to time as the Council may direct.

Fellows, Members, Associates, and Subscribers shall have the right of Free Admission to the Exhibitions of the Institute whenever they are open. All fees payable by Exhibitors and the Public shall be fixed by the Council and belong to the Institute.

A Catalogue shall be published under the direction of the Council as a permanent record of the Exhibitions.

A Library shall be formed in connection with the Institute.

A Congress shall be held by the Institute for the consideration of subjects relating to Hygiene at such times and places as the Council may direct.

THE INSTITUTE.

CORRESPONDING MEMBERS OF COUNCIL.

Bushell Anningson, m.a., m.d., Cantab.
B. Barrow, f.r.c.s., j.p., Ryde.
Jas. Henry Bennet, m.d., Weybridge, and Mentone.
Robert Beresford, m.d., Medical Officer of Health, Oswestry, Salop.
F. A. Best, m.r.c.s. Eng., Medical Officer of Health, Walthamstow.
Peter Hinckes Bird, f.r.c.s., s.sc., Certif. Camb.
A. T. Brett, m.d., Medical Officer of Health, Watford, Herts.
Philip Brown, m.d., Medical Officer of Health, Winlaton, R. Dist.
W. J. Collins, m.d., Albert Terrace, Regent's Park, N.W.
J. J. Colman, m.p., Carron House, Norwich.
The Venerable Archdeacon Denison, East Brent.
Henry Doulton, Lambeth.
Alfred Dowson, c.e., 3, Great Queen Street, S.W.
Robert Dowell, m.r.c.s. Eng., Hinderwell, Saltburn-by-the-Sea.
E. B. Ellice-Clark, c.e., Hove.
C. F. Gardner, Ashbourne.
James Gilchrist, m.d., Dumfries.
William Hardwicke, m.d., Coroner for Central Middlesex.
C. Harrison, m.d., s.sc., Certif. Camb., Lincoln.
James Livesey, c.e., 9, Victoria Chambers, S.W.
Edward Hooper May, m.d., f.r.c.s., Tottenham High Cross.
G. Melisurgo, Assoc. Inst. c.e., Socio Correspondente del Real Instituto d'Encouragiomento della Scienze di Napoli.
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Thomas Scott, Chairman Local Board, Eccleshill, near Leeds.
Isaac Shone, c. and m.e., Wrexham.
Edwyn J. Slade-King, m.d., Lic. in State Med. r.c.p. Edin., Medical Officer of Health, Ilfracombe.
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George E. Waring, junr., Colonel, c.e., Newport, Rhode Island, U.S.A.
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Dr. C. Ricord, de l'Académie de Médecine.

Dr. Ladreit de La Charrière, Médecin-en-Chef des Sourds-muets.

Dr. Charles Saffray, Sécrétaire de la Société Française d'Hygiène.

Malachia de Crestoforis, Dottor Fisico, &c., &c., &c., Milan.

Prof. e Doctor Jaetanus Peni, Milan.

Prof. Paulo Gorini, Milan.

Prof. Ludovic Brunetti, Prof. d'Anatomie Pathologique, Padua

Examination of Local Surveyors and Inspectors of Nuisances.

The great and increasing importance of the duties devolving upon Local Surveyors and Inspectors of Nuisances, in connection with the various Statutes relating to Public Health, and the Sale of Food and Drugs Act, has led the Council of the Institute to establish voluntary examinations, for Local Surveyors and Inspectors of Nuisances, and for persons desirous of becoming such or of obtaining the Certificate of the Institute.

Each Examination occupies a portion of two days. On the first day, the Examination of Surveyors is continued for four hours, viz., from 2 to 4, and 6 to 8 p.m., and consists of written papers only. Inspectors of Nuisances have two hours written examination on the first day, viz., from 4 to 6 p.m. On the second day the Examination, for both classes, commences at 11 a.m., and is *vivâ voce*, with one or more questions to be answered in writing *if deemed necessary*. A Certificate of Competence signed by the Examiners is granted to successful Candidates.

As Rural Sanitary Authorities are able under the Public Health Act, 1875, to obtain almost all the powers of Urban Sanitary Authorities it is not considered advisable to make any distinction in the Examination of the two classes of Surveyors.

As one person may, under the Public Health Act, 1875, be both Local Surveyor and Inspector of Nuisances, candidates wishing to obtain the double qualification may enter for both Examinations on the same occasion.

Candidates are required to furnish to the Council of the Institute satisfactory testimonials as to personal character, and to give two weeks' notice to the Secretary previous to presenting themselves for Examination, stating whether they wish to be examined as Surveyors, as Inspectors of Nuisances, or as both. The fee for the Examination must be paid to the Secretary, by Post Office-Order or otherwise, at least six days before the day of Examination. On receipt of the fee, a Ticket will be forwarded admitting to the Examination.

The fees payable for the Examination are as follows :—

For Surveyors . . . . £5. 5*s*.
For Inspectors of Nuisances . £2. 2*s*.

Unsuccessful candidates are allowed to present themselves a second time for one fee. Examinations during the year 1880 are appointed to be held :—

On Wednesday and Thursday, February 4th and 5th.
On Tuesday and Wednesday, June 2nd and 3rd.
On Thursday and Friday, November 4th and 5th.

Forms to be filled up by candidates previous to Examination will be supplied on application to the Secretary, 20, Spring Gardens, London.

BOARD OF EXAMINERS.

H. C. Bartlett, Esq., ph.d., f.c.s.
Alfred Carpenter, m.d. lond., s.sc. certif. camb.
Professor F. S. B. F. De Chaumont, m.d., f.r.s., Army Medical School, Netley.
Professor W. H. Corfield, m.a., m.d. oxon., f.r.c.p., University College.
W. Eassie, Esq., c.e., f.l.s.
Rogers Field, Esq., b.a., mem. inst. c.e.
Captain Douglas Galton, c.b., f.r.s.
W. H. Michael, Esq., q.c., f.c.s.
Ernest Turner, Esq., f.r.i.b.a.

SYLLABUS of SUBJECTS for EXAMINATION.

FOR LOCAL SURVEYORS.

Laws and Bye-Laws—A thorough knowledge of the Acts affecting Sanitary Authorities so far as they relate to the duties of Local Surveyors; also, of the Model Bye-Laws issued by the Local Government Board.

Sewerage and Drainage—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of Sewerage Works; the ventilating and flushing of Sewers and Drains; the internal Drainage and other Sanitary arrangements of Houses, Privies, Water-closets, Dry-closets, and the removal of refuse; the Sanitary details of Builders' and Plumbers' Work.

Water Supply of Towns and Houses—The Sanitary principles which should be observed in the preparation of schemes for, and the construction of Water-works; the various ways in which water is likely to become polluted, and the best means of ensuring its purity.

Regulations of Cellar Dwellings and Lodging Houses—General principles of Ventilation; the amount of air and space necessary for men and animals; the means of supplying air, and of ensuring its purity.

Highways and Streets—The Sanitary principles which should be observed in the construction and cleansing of Streets and Roads.

FOR INSPECTORS OF NUISANCES.

A thorough knowledge of the Provisions of the Acts and Model Bye-Laws relating to the duties of Inspectors of Nuisances; also of the Working of the Sale of Food and Drugs Act.

A fair knowledge of the Principles of Ventilation, and of simple Methods of Ventilating Rooms—Measurement of Cubic Space.
A knowledge of the Physical Characters of good Drinking-Water —the various ways in which it may be polluted, and the means of preventing pollution—Methods of Water Supply.
A knowledge of the proper Conditions of good Drainage.
The advantages and disadvantages of various Sanitary Appliances for Houses—Inspection of Builders' and Plumbers' Work.
A knowledge of what constitutes a Nuisance arising from any Trade, Business, and Manufacture.
A fair knowledge of the characteristics of good and bad Food (such as Meat, Fish, Milk, Vegetables), so as to be able to recognize unsoundness.
Some knowledge of Infectious Diseases, and of the Regulations affecting persons suffering or recovering from such diseases.
A knowledge of the best Methods of Disinfection.
Methods of Inspection, not only of Dwellings, Dairies, Milk Shops, but of Markets, Slaughter-Houses, Cow-Sheds, Bake-Houses, and Offensive Trades.
Scavenging and Disposal of Refuse.

CANDIDATES WHO HAVE RECEIVED CERTIFICATES AS LOCAL SURVEYORS.

Mr. H. W. Robinson, Ulverston; Mr. J. Parker, Bridgwater; Mr. William John Pearce Jenkins, Bodmin, Cornwall; Mr. Sidney Gompertz Gamble, Grantham, Lincolnshire; Mr. Robert Harger, Skipton, Yorks; Mr. Donald Cameron, Exeter; Mr. E. R. Trouzeau, New Brighton.

CANDIDATES WHO HAVE RECEIVED CERTIFICATES AS INSPECTORS OF NUISANCES.

Mr. F. Booker, Birmingham; Mr. W. S. Prebble, Blackburn; Mr. Thomas Blanchard, Evesham; Mr. William Frederick Watts, Amersham; Mr. Joseph Robinson, Aston Manor, Birmingham; Mr. William Wetherill, Selby; Mr. Charles Gander, Alcester; Mr. William Wilkinson, Salford; Mr. Charles Hawkes, Yeovil; Mr. Thomas Hastings Dale, Hull; Mr. Thomas T. Chubb, Whitchurch, Salop; Mr. Hugh Davies, Wrexham; Mr. William Harris, Solihull, Warwickshire; Mr. Arthur Lennox Clarke, Bedford; Mr. Benjamin Bolt, Aston, Birmingham; Mr. Joseph Osborne, Carlisle; Mr. Joshua Lapworth, Bethnal Green.

EXAMINATION PAPERS, JUNE 3, 1879.

The following questions were required to be answered in writing. A *vivâ voce* examination took place on the following day.

QUESTIONS FOR SURVEYORS.

June 3, 1879. 2 to 4 p.m.

1. Mention the chief Acts in force relating to Public Health, and give a brief statement of the objects of each. Which of these Acts refers to the Metropolis?
2. If asked to advise upon the projected drainage of a town, what would be the chief points to which you would in the first place direct your attention? Explain what would be the conditions which would limit your choice of outfall.
3. What method do you recommend for the ventilation of sewers to be laid in—
   (*a*) comparatively level towns?
   (*b*) hilly towns?
   What precautions would you take in connecting house drains with sewers? Describe how you would lay the drains in the houses themselves, and how you would make the necessary connections with water-closets, sinks, &c., &c.
4. Where a cesspool for the reception of filth—solid or liquid—is unavoidable, what precautions should be taken in respect of—
   (*a*) its position?
   (*b*) its ventilation?
   (*c*) its connection with house drains?
   (*d*) its general construction?

6 to 8 p.m.

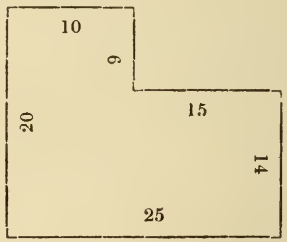
1. If asked to advise as to the water-supply of a town, what are the chief points to which you would direct your attention if the supply is to be derived—
   (*a*) from wells?
   (*b*) from streams?
2. What are the conditions of water which affect the question of the material of cisterns in houses? How is water in house cisterns likely to become polluted? What precautions should be taken to guard against such pollution? Is there any danger of pollution when the supply is constant?
3. Define what constitutes a cellar dwelling, and under what conditions may it be occupied under the Act. What are the most common causes of dampness in basement rooms, and what are the respective remedies?
4. In what way does the size of an occupied room influence the quantity of fresh air which must be supplied, and of the vitiated air which must be removed in order to keep the air of the room within a uniform limit of impurity? In what terms would you define the degree of purity of the air, and what is the limit of impurity which should be allowed for health?
5. What are the Sanitary principles which should be observed in the construction and cleansing of streets and roads?

QUESTIONS FOR INSPECTORS OF NUISANCES.

JUNE 3, 1879. 4 TO 6 P.M.

1. What is the definition of a nuisance? Give instances.
2. Mention the rules in the model bye-laws with reference to common lodging-houses. What should guide the Inspector of Nuisances in his examination of premises under this Act?
3. Define overcrowding, and explain how you ascertain if rooms *are* overcrowded.

   In the accompanying sketch, showing the plan of a room which is 12 feet high, what is the cubic space, and how many people would you allow to sleep in it?



4. In inspecting premises, to what points would you direct your attention to ascertain whether the water supply is in proper condition—
   (*a*) in the case of a water supply derived from wells?
   (*b*) in the case of a water supply by town water to cistern?
5. In inspecting houses, to what points would you direct your attention to ascertain whether the drainage is in proper condition?
6. How is butcher's meat to be recognized as being good or otherwise? What would you do if you found unsound meat exposed for sale?
7. In the case of small-pox or scarlet fever breaking out, what are your powers, and what steps would you take?
8. By what faults of construction and management are slaughter-houses most often rendered needlessly offensive, &c., and what are the rules of construction and management which it is most important to enforce with regard to slaughter-houses?

EXAMINATION PAPERS, NOVEMBER 6, 1879.

QUESTIONS FOR SURVEYORS.

NOVEMBER 6, 1879. 2 TO 4 O'CLOCK.

1. Define street. State the Law applicable to every description of street in an Urban Sanitary Authority District, and the rights and obligations and duties of Sanitary authorities, owners and occupiers therein.

2. What are the relative advantages of circular and egg-shaped sewers? In what case are they respectively preferred?
3. Give a specification of a water-tight sewer. Describe and give a sketch of the form of man-hole which you consider best adapted for ordinary town sewers, and state the rule which you adopt for determining the amount of ventilation to be afforded in a main street sewer.
4. In what way does the size and shape of a sewer affect the velocity of sewage flowing through it. If a nine-inch pipe sewer laid at an inclination of 1 in 200 gives a velocity of 3 feet per second, what velocity will it give when laid at an inclination of 1 in 800 (the pipe running full in each case)? Will this velocity suffice to keep it clear from deposits? Describe the various modes which may be resorted to for flushing sewers.
5. Give a description of the process termed intermittent downward filtration. State what area of land you would require with a gravelly soil for applying this method of purifying sewage to a town with a population of 1000 inhabitants; and state the arrangements you would adopt for dealing with the rain-water falling on the roofs, yards and streets.

November 6th, 1879. 6 to 8 o'clock.

1. In reporting upon the source of water supply for a town, which are the points to which you would direct your attention?
2. Give a sketch of a D trap, an S trap, a P trap, and a Pan Water Closet.

(Plan of a Dwelling-House annexed.)

3. Criticize the arrangements of this residence as to position of rooms, walls, doors, fire-places, windows, &c., from a Sanitary point of view.
4. Describe the drainage arrangements shown on the plan. Say whether they are satisfactory; if not, in what way they are faulty.
5. Sketch on the plan any other system of drains which you would think preferable.
6. Describe in detail the arrangements necessary for the water-supply of the residence; a bath being fixed in the room over the serving-room, a W.C. on the first floor over that on the ground floor, and a housemaid's sink near.

QUESTIONS FOR INSPECTORS OF NUISANCES.

November 6, 1879. 4 to 6 o'clock.

1. What power of entry can be exercised by an Inspector of Nuisances?
2. What books should an Inspector keep, and how should he enter his work in them?
3. What is a water-trap? What are its objects? Give examples of good and bad traps.

4. What materials are used for soil-pipes? Which do you prefer? What faults are likely to be found in them? How should they be ventilated?
5. Mention some offensive trades. Describe what points you would look to in inspecting any one of them with which you are acquainted?
6. A case of typhus fever is reported to you. What would you do?
7. What is a cellar-dwelling? Under what conditions may it be legally inhabited?
8. How do you recognize diseased meat? If you found such meat exposed for sale, what would you do?

Visitors duly appointed by the following bodies are invited to be present at the Examinations; *(a)* The Local Government Board; *(b)* The Institute of Civil Engineers; *(c)* Associations of Medical Officers of Health; *(d)* The Royal Institute of British Architects; *(e)* The Association of Municipal and Sanitary Engineers and Surveyors; *(f)* The Institution of Surveyors.

Fellows, Members, Associates, and Subscribers will receive notice from time to time of the dates upon which the Annual and General Meetings will be held during the year.

REPORT OF THE JUDGES OF THE EXHIBITION HELD AT CROYDON, 1879.

We, the undersigned, the Judges appointed by the Council, beg leave to recommend to the Council the following distribution of Medals and Certificates.

MEDALS.

We recommend that MEDALS should be awarded to the under-mentioned Exhibitors:—

Aveling and Porter, *Rochester*, for Improved Six-Ton Steam Road Roller.

Doulton and Co., *Lambeth*, for Patent Anti-Percussion High-Pressure Valves.

Fraser, Bros., *Commercial Road East, London*, for Patent Portable Disinfecting Apparatus.

Hamilton and Co., 255, *Kingsland Road, London*,, for Patent Prismoidal Pavement, and Floor Lights.

Lascelles, William, 121, *Bunhill Row, London*, for Concrete Bath, in one piece.

Sinclair, James, 104, *Leadenhall Street, London*, for "Tyndall's" Smoke Respirator.

Walker, Charles W., 1, *Chivalry Road, Wandsworth Common*, for Acid Pump and Syphon.

Wenham, W. P., 81, *Church Street, Croydon*, for an Improved Open or Closed Range Kitchener.

Willcocks and Co., *Burmantofts, Leeds*, for Silica Glazed and Enamelled Fire Clay Bricks and Faïence.

CERTIFICATES.

We further recommend that CERTIFICATES of MERIT be awarded to the undermentioned Exhibitors:—

Adams, R., 7, *Great Dover Street, London, S.E.*, for Patent Adjustable Shoe, and Regulating Spring Hinge for Swinging Doors.

Adams, R., 7, *Great Dover Street, London*, for Fanlight Openers and Casement Fasteners.

Ball, Ancell, *Spalding, Lincolnshire*, for Patent Folding Invalid Bed.

Beard, Dent, and Hellyer, 21, *Newcastle Street, Strand, London, W.C.*, for Patent "Ventilating Drain Syphon."

*Billing and Co., *Hatton Garden, London, W.C.*, for the "Workman's" Cooking Stove, and other Improvements in Gas-Cooking Stoves.

Bird, Peter Hinckes, f.r.c.s., 1, *Norfolk Square, London*, for his method of "Costless Ventilation."

Bray and Co., *Blackman Lane, Leeds*, for Improved Gas Burners.

Bussey and Co., *Museum Works, Rye Lane, Peckham, London*, for Patent Spring Mattress.

*Chorlton and Dugdale, 19, *Blackfriars Street, Manchester*, for "Excelsior" Spring Mattress Hospital Beds.

Clark, F. W., Portable Gas Apparatus Company (Limited), *Great Queen Street, Lincoln's Inn Fields, London, W.C.*, for Patent Portable Gas Apparatus, for Manufacturing Gas from Gasoline.

Doulton and Co., *Lambeth*, for Decorative Tiles for covering walls and floors.

Doulton and Co., *Lambeth*, for Disconnecting Gully, with back and side entrances and iron grating.

Edwards, J. C., *Trefynant, Ruabon, North Wales*, for Dean's Patent External Drain Traps, with movable receptacle.

*Ellison, J. E., *Victoria Square, Leeds*, for Conical Ventilators.

Finch and Co., *Sanitary Works*, 181, *High Holborn, London, W.C.*, for Large-way Waste Plug, with protective cover.

Hammond and Hussey, *High Street, Croydon*, for Hornibrook's Patent Catchment Grating for Steep Gradients.

Headley and Son, *Exchange Ironworks, Cambridge*, for Patent Hose Reel.

Hygienic Stove and Grate Company, 15, *Peel Buildings, Birmingham*, for "Eagle" Sanitary Trap, for superseding Bell Traps.

Jennings, George, *Stangate, London*, for "Artizans Dwellings Sink."

Jennings, George, *Stangate, London*, for "Universal" Shampooing Apparatus.

KNELL, U., 77, *Fore Street, London, E.C.*, for his "Imperial" Ventilating Window.

*LEGRAND and SUTCLIFFE, 100, *Bunhill Row, London, E.C.*, for Improvements in internal driving of Tube Wells.

LEWIS, Mrs. AMELIA, 37, *Blackfriars Street, Manchester*, for Patented Tin Cooking Utensils.

*MOULE'S PATENT EARTH CLOSET Co. (Limited), 5*a*, *Garrick Street, London, W.C.*, for Patent Earth Closet.

ONIONS, JOHN C. (Limited), *Birmingham*, for Moser's Patent Self-Acting Dry Closet.

PATENT VICTORIA STONE COMPANY, 305, *Kingsland Road, London*, for Artificial Stone Tubes.

*POCOCK BROTHERS, 235, *Southwark Bridge Road, London, S.E.*, for "Universal" Tubular Air and Water Bed.

PRITCHETT, G. E., F.S.A., *Bishops Stortford*, for Barometrical and Thermometrical Instruments.

*PRITCHETT, G. E., F.S.A., *Bishops Stortford*, for Improvements in Hollow Tile Flooring.

RANSOME, S. E. and Co., 10, *Essex Street, Strand, London*, for Milwaukee Glass Lantern or Hurricane Lantern.

*SANITARY APPLIANCE COMPANY, *Factory Lane, Salford*, for Morrell's Patent Cinder-Sifting Ash Closet.

SELIG, SONNENTHAL and Co. (Limited), *Lambeth Hill, Queen Victoria Street, London, E.C.*, for Patent Safety Belt Shippers.

SHARP, JONES, and Co., *Bourne Valley Pottery, Poole, Dorset*, for Rock Concrete Tubes.

SINCLAIR, JAMES, 104, *Leadenhall Street, London*, for Chemical Fire Exterminator.

STIDDER and Co., 50, *Southwark Bridge Road, London, S.E.*, for Swivel, Lock Plug and Overflow for Sinks.

STRETTON, SAMUEL, M.R.C.S., *Kidderminster*, for a Folding Bier and Car, for simplifying funerals.

WALLER, THOMAS, 47, *Fish Street Hill, London*, for Cooking Stove with Warm-Air Chamber.

WEBSTER and Co., *Market Street, Nottingham*, for Webster's Patent Photometer.

WENHAM, W. P., 81, *Church Street, Croydon*, for Boyle's Mica Valved Outlet Ventilator.

WILLCOCK and Co., *Burmantofts, Leeds*, for Fire Clay Sanitary Sinks and Water Troughs.

There are two classes of exhibits which we recommend should be excluded from awards of Medals—namely, those which were exhibited at Leamington or Stafford and to which a Medal was then awarded; some of which we recommend should receive Certificates, and these we have distinguished in the foregoing lists by asterisks; and secondly, objects exhibited or invented by any of the Judges themselves, such as Mr. WILLIAM EASSIE'S exhibit of Specimens of "Bad Plumbing," and Mr. ROGERS-FIELD'S Self-Acting Flush Tank, exhibited by Messrs. H. DOULTON and Co.

The undermentioned articles we are unable to express an opinion

upon without testing; and we recommend that they should be tested at the expense of the Exhibitors, if they are willing to incur the same.

DEFERRED FOR PRACTICAL TRIAL.

Aërated Waters.

Evans and Co., *Wrexham*, Zoedone (Patentee, David Johnson, F.C.S.)

Gulliver and Co., *Aylesbury*, Mineral and Aërated Waters.

Newry Mineral Water Co. (Limited), *Islington*, *Liverpool*, Ginger Ale, Ginger Beer, Lemonade, &c.

Packham, James, 16, *Catherine Street*, *Croydon*, Aërated Waters in Silvered Syphons; Specialité Seltzer Water.

Disinfectants.

Calvert and Co., *Bradford*, *near Manchester*, Carbolic Acid.

Jeyes' Sanitary Compounds Company (Limited), 54½, *Bishopsgate Street Within*, *London*, *E.C.*, Jeyes' Perfect Purifier.

Jones, W., 37, *Mincing Lane*, *London*, Lustro-Disinfecting Fluid.

Mackey, Sellers, and Co., 102, *Bouverie Street*, *London*, Oxychlorogene.

Sanitas Company, *Three Colt Lane*, *Bethnal Green*, Sanitas Disinfecting Fluid.

Sutton and Phillips, *Stowmarket*, Sporokton (Professor Tuson's Patent).

White, W. T., 232, *Kennington Road*, *London*, Euchlorine Disinfectant.

Filters.

Flood and Co. (Limited), *Holland Street*, *Blackfriars Road*, *London*, *S.E.*, Bailey Denton's Filter.

Maignen, P. A., 22 and 23, *Great Tower Street*, *London*, *E.C.*, Patent "Filtre Rapide."

Ransome, S. and E., & Co., 10, *Essex Street*, *Strand*, *London*, Porous Slabs and Rain-Water Filters.

Hopper Closets (one specimen each).

Beard, Dent, and Hellyer, 21, *Newcastle Street*, *Strand*, *London*, *W.C.*, Artizan Closet.

Carsley, W. S., 18, *Bartholomew Close*, *London*, *E.C.*, Jewell's Hopper Closet Basin with Washer Clip, and Iron Trap with connecting T piece in one casting.

Doulton and Co., *Lambeth*, *London*.

Ramsey, William (Limited), *Farringdon Street*, *London*, *W.C.*, Dodd's Ventilating Hopper Closet.

Smith, Thos. and Co., *Old Kent Road*, *London*, *S.E.*

Stidder, J. G., 50, *Southwark Bridge Road*, *London*, *S.E.*, Infirmary Closet.

Warner and Sons, *Cripplegate*, *London*, *E.C.*, Sharp's Hopper Closet.

"Wash-out" Closets (one specimen each).

Bostel, D. T., 18 and 19, *Duke Street, Brighton*, Brighton Excelsior.

Doulton and Co., *Lambeth, London.*

Owen, Henry, 16, *Sussex Place, South Kensington, London.*

Ramsey, William (Limited), *Farringdon Street, London*, Dodd's Ventilating "Wash-out."

Stidder, J. G., 50, *Southwark Bridge Road*, Single-Arm Flushing Monkey.

Special Closets.

Doulton and Co., *Lambeth*, Fowler's Self-acting Closet.

Washing and Wringing Machines (one specimen each).

Bell, J. M. and Co., 491, *Oxford Street, London.*

Bradford, Thomas, 60, *High Holborn, London.*

Donald and Co., 33, *Cornhill, London.*

Green, Thomas and Son (Limited), 54, *Blackfriars Road, London*, Monarch Washing, Wringing and Mangling Machine.

Ryan and Ryan, *Imperial Arcade, Ludgate Hill, London.*

Twelvetrees, Harper, 40, *Finsbury Circus, London.*

Water Heaters.

Davis, M. and C., 286-290, *Camberwell Road*, and 1, *The Pavement, Clapham Common, London*, Gas Bath, with Copper "Tudor" Boiler.

Ewart and Son, 406, *Euston Road, London, N.W.*, Crown Gas Boilers, for instantly turning cold water into hot. Gas Baths.

Hammond and Hussey, 10 & 11, *High Street, Croydon*, an Improved Gas Bath and Boiler complete.

Hellier, William, 19, *Duke Street, Grosvenor Square, W.*, Two Instantaneous Water Heaters, heated by Gas.

Mart and Bradley, 16, *York Street, London Road*, and 109, *Fenchurch Street, London, E.C.*, the Instanter Bath, Water Heater, and Thermal Font, Cabinet Wash Stand, with Water Heater attached.

Siddaway, E. and Sons, *George Street, West Bromwich*, a Patent Water Heater for Baths, to heat a gallon of water per minute to 100 degrees, a Patent Water Heater for Lavatories.

Miscellaneous.

Braithwaite and Co., *Swinegate, Leeds*, Patent Syphon for Water-Closet Cisterns.

Carsley, W. and S., 18, *Bartholomew Close, London*, Urinals, Iron Traps, and Sink, coated by Professor Barff's process.

Finch and Co., 60, *High Holborn, London*, a 4-inch Ball Valve for large Cisterns with Balanced Valves.

Gardner, Frederick, *Hereford Road, Bayswater, London*, Patent Level Cot for use on shipboard.

Keen and Son, *Church Street, Croydon*, Gay's Solution.

Lascelles, William, 21, *Bunhill Row, London*, Concrete Constructions.

Potter and Sons, *Oxford Street, London*, H. Saxon Snell's Patent Ventilating Hot-Water Open Fire-Grate (The Thermhydric).

Pamphillon and Co., *Whittlesford, Cambridge*, Patent Smoke Consumer (Peyton's Patent).

Read, Jefferson, *Arcanum Plating Works, Birmingham*, The Arcanum Process of Silver Plating Steel.

Ryan and Ryan, *Imperial Arcade, Ludgate Hill, London*, Rain-Water Percolators.

Silicate Paint Company, *Charlton, Kent*, Enamel Paint, Petrifying Liquid and Paints exhibited.

Stidder and Co., 50, *Southwark Bridge Road, London*, Urinette.

Woollams, W. and Co., 110, *High Street, Manchester Square, London*, Paper Hangings stated to be free from Arsenic.

Until the deferred trials have been carried out we are unable to award the Gold Medal of the Institute.

We have found that alterations have been made in certain exhibits to which Medals or Certificates were given, by which alterations some of the essential merits for which the Medals or Certificates were awarded have been destroyed. Notwithstanding such alterations, the exhibits are advertised and stamped as having received the Medals or Certificates. We therefore recommend that notice of this should be taken by the Council; and that in future each person receiving Medals or Certificates should be warned against using the name of the Sanitary Institute in connection with any article which has been altered since the award was made.

We also advise that in future the Exhibitors must give full particulars of each exhibit in order that a proper number may be fixed to it in the Catalogue.

(Signed) W. H. Corfield.
Rogers Field.
W. Eassie.
H. C. Bartlett.
Judges.

NOTICE TO EXHIBITORS.

The Exhibitions of Sanitary Appliances are held annually in connection with the Autumn Congress, and unpatented exhibits are protected by a certificate granted by the Board of Trade, under the Protection of Inventions Act, 1878.

Judges are appointed by the Council to examine the several exhibits, and award Medals and Certificates of merit to such objects as they may consider worthy.

In addition to the Ordinary Medals, a special Gold Medal is offered by the Institute, for a selected exhibit from the entire exhibition, and will be awarded by the Judges, in case of pre-eminent merit only. Selected exhibits of such a nature as to require practical trials which cannot be carried out on the spot, are submitted to such further trials upon the Exhibitors' defraying the necessary expenses.

The following table gives particulars with reference to the exhibitions already held.

TABLE A.

		1877. Leamington.	1878. Stafford.	1879. Croydon.
1	Number of Exhibitors .	117	116	189
2	" of Exhibits . .	294	319	710
3	Space occupied . . .			
4	Number of days Exhibition was open . . .	14	16	17
5	Total number of Visitors .			
6	Number of Medals awarded	13	12	9
7	Number of Certificates awarded . . .	None.	26	40
8	Number of Exhibits deferred for further trial . .		7	52

REPORT OF THE JUDGES OF THE EXHIBITION HELD AT STAFFORD, 1878.

THE SPECIAL MEDAL OFFERED BY DR. RICHARDSON FOR A SELECTED EXHIBIT TAKEN FROM THE ENTIRE EXHIBITION WAS AWARDED TO

SILICATE PAINT COMPANY, for Griffiths' Patent White.

THE MEDAL OF THE INSTITUTE WAS AWARDED TO THE FOLLOWING.

POCOCK BROTHERS, *Southwark Bridge Road, London*, for their Universal Invalid Tubular Water and Air Beds.

BILLING & CO., *Hatton Garden, London*, for their Apparatus for Cooking by Gas.

S. LEONI & CO., *Strand, London*, for their Apparatus for Cooking by Gas.

THE SILICATE PAINT COMPANY, *Cannon Street, London*, for Griffiths' Patent White, and for their Preparations of Silicate Paint, Enamel Paint and Petrifying Liquid.

DOULTON & CO., *Lambeth, London*, for Stanford's Patent Joints for Stoneware Pipes.

MOULE'S PATENT EARTH-CLOSET COMPANY, *Garrick Street, London*, for their Earth Closets.

MAJOR F. DUNCAN, R.A., *the Common, Woolwich*, for Ambulance Wheeled Litter.

THE SANITARY APPLIANCE COMPANY, *Factory Lane, Salford*, for Portable Cinder Sifting Ash-closet, with Soil Pail.

G. E. PRITCHETT, *Fish Street Hill, London*, for Economic Hollow Flooring.

HASSALL & SINGLETON, *Phœnix Foundry, Freeman Street, Birmingham*, for the Phœnix Portable Range, and the Birmingham Range, with Reducible Fire, without Gas.

JAS. E. ELLISON, of Leeds, for Conical Ventilators.

MORRIS, LITTLE, & CO., of Doncaster, for Little's soluble Phenyle.

TO RECEIVE *Certificates of Merit.*

James Stiff & Sons, Lambeth, London, for Weaver's Ventilating Sewer Air Trap.

Potts & Co., Handsworth, Birmingham, for The Patent Edinburgh Air Chambered Sewer Trap.

**Thomas Bradford & Co.*, Crescent Iron Works, Salford, for new Patent "Shuttle" Steam-power Washing Machine.

Thomas Allen, St. Augustine's Parade, Bristol, for Patent Metallic Tubular Bedsteads and Invalid Bedrests.

William Hamilton, Ship Street, Brighton, for Invalid Grasshopper Couch.

**Chorlton & Dugdale*, Blackfriars Street, Manchester, for "Excelsior" Patent Spring Mattress.

Ruffard & Co., Clay Works, Stourbridge, for their Porcelain Baths, Moulded and Glazed in one piece.

W. H. Hilton, Spencer Street, Leamington, for Various Inventions for promoting Domestic Economy.

**F. and C. Hancock*, Dudley, for Machine for Washing and Cooling Butter.

**G. H. Harris*, Bristol Street, Birmingham, for Economical Cooking Range.

The Patent Composite Fire-light Company, Fenchurch Street, London, for The Compostella Fire-lights, for lighting fires.

S. Leoni & Co., Strand, London, for The "Rheometer" Street-Lamp Regulator.

London Necropolis Company, Lancaster Place, Strand, for Patent "Earth to Earth" Coffins.

Thomas Larmouth & Co., Cross Lane, Salford, for Dual Desk with separate Gangway Seat.

Colman & Glendenning, Chalk Hill Works, Norwich, for School Desks with Shifting Seats.

Gillow & Co., Oxford Street, London, for Patent Lavatory.

Isaac Shone, Wrexham, for Pneumatic Liquid Ejector.

Oates and Green, Horley Green Fire Clay Works, Halifax, for Patent Drain-cleaning Rods and Stoneware Horse Manger.

The Ladies' Sanitary Association, Berners Street, London, for their Publications.

H. Snell, Southampton Buildings, Chancery Lane, London, for the Thermhydric Patent Ventilating Hot Water Open Fire Grate.

G. E. Pritchett, Fish Street Hill, London, for Warming and Ventilating Appliances and for Thermometrical Instruments.

Thorn & Co., Stafford, for Patent Artificial Stone Filters for cleansing Rain Water for Domestic Use.

**B. B. Haresceugh & Co.*, Bentinck Street, Leeds, for Excreta Pail (oak) with Patent Spring Lid.

**Daniel Thomas Bostel*, Duke Street, Brighton, and Golden Lane, London, for Patent "Excelsior" Water Closet.

Bartrum, Harvey, & Co. of London, for Patent Ventilatorium Waterproof Garments.

Jewsbury & Brown, of Manchester, for Seltzer Water.

* Those marked thus have had the Medal of the Institute awarded to them at a previous Exhibition.

MEDALS awarded by the INSTITUTE to Exhibitors at Leamington, 1877.

John Borwell, Britannia Foundry, Burton-on-Trent, for improved Washer with Table complete.

Daniel Thomas Bostel, Duke Street, Brighton, and 10, Golden Lane, London, for Patent Excelsior Water Closet.

Thomas Bradford and Co., Crescent Iron Works, Salford, for New Patent "Shuttle," (Q) Steam Power Washing Machine, specially adapted for use in Hospitals and Asylums.

Calvert and Co., Manchester, for "Calvert's" Carbolic Acid for Disinfecting purposes.

Chorlton and Dugdale, Blackfriars Street, Manchester, for "Excelsior" Patent Spring Mattress.

Thomas Galbraith, Crawford Square, Londonderry, for Patent Hot-air Bath.

F. and C. Hancock, Dudley, Worcestershire, for Machine for Washing and Cooling Butter.

B. B. Haresceugh and Co., Bentinck Street, Leeds, for Excreta Pail (oak), with Patent Spring Lid.

G. H. Harris, Bristol Street, Birmingham, for Economical Cooking Range.

Le Grand and Sutcliff, 100, Bunhill Row, London, for Improvements in Well-sinking Apparatus.

John Parker, Woodstock, Oxford, for Dry Earth Closet.

Spongy Iron Water Purifying Company, 505, Oxford Street, London, for Bischof's Spongy Iron Filter.

Société Française D'Hygiéne, for Chemical Preparations and Apparatus.

ADDRESSES AND PAPERS READ BEFORE THE INSTITUTE.

SUBJECT.	NAME OF AUTHOR.	DATE.
The Necessity for Further Sanitary Legislation, with special reference to Mr. Sclater-Booth's Pollution of Rivers Bill.	C. F. Gardner	July 13th, 1876.
Mode of Treating Town Sewage	Sir Joseph Bazalgette, C.B. ...	March 14th, 1877.
Future of Sanitary Science *(Annual Address)*	Dr. Richardson, F.R.S. ...	July 5th, 1877.
Consumption and Climate	Dr. Prosper de Pietra Santa	July 6th, 1877.
A Theory as to the Natural or Glandular Origin of the Contagious Diseases.	B. W. Richardson, M.D., F.R.S.	At the Congress held at Leamington, Oct., 1877.
The Past and Future of Sanitary Science	G. Wilson, M.A., M.D. ...	"
The Present Possibilities of Sanitary Legislation ...	R. Brudenell Carter, F.R.C.S.	"
Work of the Birmingham Interception Sub-Committee ...	Lawson Tait, F.R.C.S. ...	"
Demonstrations of the various systems which have been adopted in late Cremations of the Human Body.	W. Eassie, C.E.	"
Demonstration on the passage of Gases through water in Traps—Lead Pipes corroded by Sewer Gas—Samples of improper plumbing taken out of Houses.	J. A. Russell, M.A., M.D. ...	"
Sewage, Sewerage and Town Refuse	Lieut.-Col. Jones, V.C. ...	"
Turpentine and Terebine	T. Moffat, M.D., F.R.G.S. ...	"
Influence of Climate on Health	Professor F. S. B. F. de Chaumont, M.D.	"
Treatment of Domestic Sewage	W. White	"
Law or Caprice in Contagion	J. Sinclair Holden, M.D. ...	"
Water for Domestic Use	H. C. Bartlett, PH.D., F.C.S. ...	"

SUBJECT.	NAME OF AUTHOR.	DATE.
The Diminution of Insanity which took place during the Political Commotions in France.	Rev. E. Wyatt-Edgell ...	At the Congress held at Leamington, Oct., 1877.
Sewage Disposal and Sanitary Carbon	Burton Green	"
The necessity of Plumbers and Builders possessing a competent knowledge of the Laws of Health as bearing on their respective occupations.	J. A. Russell, M.A., M.B. ...	"
Cremation—A Sanitary Institution	W. Eassie, C.E., F.L.S. ...	"
Sanitary condition of Leamington	Joseph S. Baly, M.R.C.S. ...	"
Missing Links in the Sanitary Administrative Service ...	T. J. Dyke, F.R.C.S. ...	"
Woman's Work in relation to Sanitary Science	Miss Rose Adams	"
Sanitary Work in English Watering Places	Edwyn Slade-King, M.D. ...	"
Supply and Storage of Water at East Brent	Ven. Archdeacon Denison ...	"
Home, Sweet Home	Ernest Turner, F.R.I.B.A. ...	"
Effects of Growing Vegetation upon Human Health ...	W. Eassie, C.E., F.L.S. ...	"
New Artesian Water Supply at Leamington	Horace Swete, M.D. ...	"
The Dwellings of the Poor in large Towns	Henry C. Burdett	"
The Influence of the Movement of Subterraneous Water on Health.	Baldwin Latham, M.INST. C.E., F G.S., F.M.S.	"
On the Present and Future Work of Engineers in reference to Public Health.	William Donaldson, M.A., M. INST. C.E.	May 31st, 1878.
The Pollution of Rivers and its effects upon the Fisheries & Water Supply of Towns and Villages (*Annual Address*).	Frank Buckland, M.A. ...	July 3rd, 1878.
The need of reform in the administrative organization of the Sanitary Service, with special reference to the appointment of Medical Officers of Health.	Edwin Chadwick, C.B. ...	At the Congress held at Stafford, October, 1878.

SUBJECT.	NAME OF AUTHOR.	DATE.
Ozone in relation to Health and Disease	Dr. Henry Day, F.R.C.P. ...	At the Congress held at Stafford, October, 1878.
The constitution and function of a Ministry of Health for the United Kingdom.	Dr. B. W. Richardson, LL.D., F.R.S.	"
Sanitary Co-operation	Sir Henry Cole, K.C.B. ...	"
The Progress of Air Testing	Angus Smith, PH.D , F.R.S. ...	"
Thames Water : its impurities, dangers, and contaminations. Remedy suggested.	Henry C. Burdett	"
The Sewerage of Ancient Rome	W. Eassie, C.E., F.L.S. ...	"
The Administration of Public Health Laws	E. B. Ellice-Clark, C.E. ...	"
Some Hygienic Conditions of the Pottery Manufacture ...	J. T. Arlidge, M.D., F.R.C.P....	"
The Sanitary Defects of Old Towns and Suggested Remedies.	W. Ellis Clendinnen, and James B. M'Callum.	"
The Water Supply of Stafford	William Molyneux, F.G.S. ...	"
River Inundations	William Molyneux, F.G.S. ...	"
The works projected and undertaken during the last thirty years for the Supply of the principal Towns in the County of Staffordshire with Water...	Henry J. Marten, M. INST. C.E.	"
Some observations with respect to the Drainage of the Populous Manufacturing Towns situate upon the Drainage Area of the River Tame and its tributaries north of Birmingham, and as to the means to be adopted to prevent the present and future Pollution of that River.	Henry J. Marten, M. INST. C.E.	
Public Mortuaries for large Towns	William Hardwicke, M.D. ...	"
Hospitals for Infectious Diseases	Ernest Turner, F.R.I.B.A. ...	"
The Preventive System of Medical Practice	William Ogle, M.D., F.R.C.P.	"

SUBJECT.	NAME OF AUTHOR.	DATE.
Sanitary Science	Robert Rawlinson, C.B., Chief Inspect. of the Eng. Depart. of the Local Govt. Board.	At the Congress held at Stafford, October, 1878.
Progress in Purifying Sewage by Precipitation	Henry Robinson, C.E. ...	„
The Disinfection of Hospital Drains	William Soper, M.R.C.S. ...	„
The Chemistry of Dirt	H. C. Bartlett, PH.D., F.C.S.	„
The Periodical Sanitary Inspection of Houses	D. H. Monckton, M.D. ...	„
The paramount importance of considering economy in all measures undertaken for Sewage Disposal.	Lieut.-Col. Jones, V.C. ...	„
The Compulsory Registration of Infectious Diseases, with special reference to its working at Bolton.	Edward Sargeant, L.R.C.P. ...	„
The necessity for employing more uniform terms in literature relating to Sewage Disposal.	J. C. Melliss, C.E.	„
A New Process for Testing Air	Professor Wanklyn and W. J. Cooper.	„
The New Pneumatic Sewerage System as compared with Captain Liernur's and existing Gravitation Systems.	Isaac Shone, C.E. and M.E., F.G.S.	„
New method of preventing the entrance of Sewer Air into houses.	G. A. Heron, M.D.... ...	„
The natural principle which should determine the boundaries of Drainage Districts.	Henry Law, M. INST. C.E. ...	„
The advantage of Temperance for the maintenance of Military Force.	Lieut.-Col. Geary, R.A. ...	„
The special provision needed for the maintenance of Military Force by distinct Sanitary Service for the Army.	Lieut.-Col. Geary, R.A. ...	„
Facts upon Sewage Farming	R. W. Peregrine Birch, C.E.	„

SUBJECT.	NAME OF AUTHOR.	DATE.
Leprosy and its prevention by Sanitary means	Gavin Milroy, M.D., F.R.C.P.	At the Congress held at Stafford, October, 1878.
The Works in progress for the Water Supply of Stafford ...	William Dennis, C.E. ...	"
The best mode of replacing the Rookeries and Effete Tenements lately removed by the Corporation of London.	John Balbirnie, M.D., M.A. ...	"
The Establishment of a School for the technical teaching of Sanitary Science.	Lory Marsh, M.D.	"
Food and Drink	James Russell, M.A., M.B. ...	"
Artificial Collecting Grounds for Water Supply... ...	A. Ormsby, M. INST. C.E. ...	"
Sanitary Engineering in America	Colonel E. Waring, Jun., C.E.	"
Water Economy *(Annual Address)*	G. J. Symons, F.R.S. ...	July 10th, 1879.
Salutland	B. W. Richardson, M.D., F.R.S., *President of the Congress*	At the Congress held at Croydon, October, 1879.
The First Principles of Sanitary Work	Alfred Carpenter, M.D. (*President of Section I.*)	"
On certain points with reference to Drinking-Water ...	Francis S. B. François de Chaumont, M.D., F.R.S.	"
Interpretation of Water Analysis for Drinking Purposes ...	Horace Swete, M.D., C.S.S.Camb.	"
Preventable Mortality. The Mortality from Alcohol ...	Norman Kerr, M.D., F.L.S. ...	"
The Relation of Alcohol to Bad Sanitation	J. James Ridge, M.D. ...	"
On the Importance of thorough Ventilation in Dwellings	H. T. Strong, M.D. ...	"
Infant Mortality	F. Nichols	"
On Common Lodging-house Accommodation	F. Vacher	"

SUBJECT.	NAME OF AUTHOR.	DATE.
The Influence of efficient Sanitation in the Prevention of the Himalayan Plague	C. R. Francis	At the Congress held at Croydon, October, 1879.
The Unhealthiness of Public Institutions	Henry C. Burdett	„
Nurses : How to make them, how to use them, how to pay them	W. Ogle, F.R.C.P., M.D. ...	„
Some Remarks on Hereditary Influence	E. Wyatt-Edgell	„
On Simplicity, Common Sense, and Intelligent Supervision in Sanitary Appliances	Peter Hinckes-Bird, F.R.C.S. C.S.S. Camb.	„
On Nature's Hygiene	F. C. Kingzette, F.C.S. ...	„
Address	Douglas Galton, C.B., D.C.L., F.R.S. (*President of Section II*)	„
Remarks on certain points in the Work of the Engineer, which have a direct bearing on Public Health	Bailey Denton, C.E. ...	„
The Dangers of Bad Plumbing	W. Eassie, C.E.	„
On the Effects of the long-continued application of Sewage Water to the same Land	Major-Gen. H. Y. D. Scott, C.B., R.E., F.R.S.	„
The Sanitation and Draining of Towns, and Disposal of Sewage	W. Hempson Denham, SOC. COLL. CHIR., S.P.M., F.L.S., F.S.S., M.S A.	„
On Heating and Ventilating	C. Henderson	„
Observations upon Effective Ventilation	H. C. Stephens	„
Ventilation : Position of Inlets and Outlets	J. G. Ellison	„
On the necessity for an Improved System of Ventilating, Heating and Cooling Crowded Human Habitations or Places of Assembly ; especially in Hot Seasons or Climates	John Balbirnie, M.A., M.D. ...	„

SUBJECT.	NAME OF AUTHOR.	DATE.
The Necessity for a Permanent Registration of House Drains	S. Parsons-Smith, M.K.Q.C.P., L.R.C.S.I.	At the Congress held at Croydon, October, 1879.
Address	C. J. Symons, F.R.S. (*President of Section III.*)	"
Geology in relation to Sanitary Science	Alfred Haviland, M.R.C.S. ...	"
On the Quantitative Elements in Hydrogeology ...	Joseph Lucas, F.G.S. ...	"
Particulars of an Artesian Well at Thames Haven ...	W. Barnes Kinsey... ...	"
Rain collected from Roofs considered as a Domestic Water Supply	H. Sowerby Wallis, F.M.S. ...	"
On some of the apparent Influences of the Weather upon the prevalence or otherwise of certain classes of Disease	Geo. Corden	"
Conditions of the Water Supply of Croydon in relation to its Rainfall and Geology; with Suggestions for its Sanitary and Profitable Improvement	Wm. F. Stanley, F.M.S. ...	"
Sanitary Fallacies	W. H. Corfield, M.A., M.D. Oxon., F.R.C.P. Lond.	"
Disinfection of Excreta	William Soper, M.R.C.S.L., L.S.A.	"
The Softening and Purification of Water by the Process of the late Professor Clark; with a Notice of a System by which it is rendered more generally available	T. H. Porter	"
On the Norma of Sanitation in the School Stages of Life	Edwin Chadwick, C.B. ...	"
On Health at Home	B. W. Richardson, M.D., F.R.S.	"
Health and Good Food	F. de Chaumont, M.D., F.R.S.	"
Health and Good Air	Douglas Galton, C.B., D.C.L., F.R.S.	"

SUBJECT.	NAME OF AUTHOR.	DATE.
Health and Pure Water	G. J. Symons, F.R.S. ...	At the Congress held at Croydon, October, 1879.
Health out of Doors	J. H. Strong, M.D.	"
On the Technical Work of the Sanitary Institute of Great Britain	Lory Marsh, M.D.	"
The Lessons taught at the Exhibition	Alfred Carpenter, M.D. ...	"
On Infantile Mortality	Edwin Chadwick, C.E. ...	"
On Mistakes about Health	W. H. Corfield, M.A., M.D. Oxon., F.R.C.P. Lond.	"

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Marsh, Lory, m.d., Greenhithe, Kent
Mason, J., j.p., Lynsham Hall, Witney, Oxon
Moffat, T., m.d., f.r.g.s., Hawarden
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Northumberland, His Grace the Duke of, 2, Grosvenor Place, S.W.
Ohren, Magnus, assoc. inst. c.e., f.c.s., Lower Sydenham, S.E.
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Ollard, William Ludlam, High Cliffe Lodge, Lyme Regis, Dorset
Paget, J., j.p., Stuffynwood, Mansfield
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Richardson, J., Methley Park, Leeds
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MEMBERS AND ASSOCIATES.

* *Those marked thus are Life Members and Associates.*

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Addis, William Judson, Prome, British Burmah
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Ball, F., 18, Bell Street, Henley-on-Thames
Banner, E. G., 11, Billiter Square, E.C.
Barber, S. J., Eastwood, Notts.
Barnacle, J., Great Gonerby, Grantham

Barrow, B., F.R.C.S., J.P., Ryde, Isle of Wight
Barr, Alexander, M.D., Northampton
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Beard, Neville, The Mount, Ashbourne
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Bennett, Alderman W., Heysham Tower, Lancaster
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Beresford, Robert, M.D., Oswestry, Salop
Best, F. A., M.R.C.S., Walthamstow
Bickersteth, E. R., F.R.C.S., Liverpool
Bindley, Captain, Burton-on-Trent
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Bolam, H. G., Ingestre, Stafford
Bolding, I. T., 19, South Molton Street
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Bower, Thomas, Lytham, Lancashire
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Burn, R. S., C.E., Oak Lea, Edgeley Road, Stockport
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Chester, John, 5, Old Square, Lincoln's Inn
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Mayor of Stoke, The (Alderman Minton)
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Parker, W. C., c e., Whitehall Club, S.W.
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Shrimpton, C., m.d. Paris, 5, Whitehall
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Simons, William, Merthyr Tydfil

Skrine, H. D., Warleigh Manor, Bath
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Taylor, John W., m.d., d.sc., 34, Queen Street, Scarboro'
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Thompson, James, a.b., m.d., m.r.c.s., Leamington
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Underhill, A. S., b.a., m.b., Great Bridge, Tipton, Staffordshire
Vulliamy, George, f.r.i.b.a., Metropolitan Board of Works
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Yuill, W., c.e., Fenchurch Avenue, E.C.

SUBSCRIBERS.

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Cobham, G., Gravesend
Coles, Cowper, 2a, Albany, Piccadilly
Denton, W. T., Southsea
Domenichetti, Dr., Deputy Inspector-General, h.p., Medical Officer of Health, Louth combined District
Fleetwood Local Board, The
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Jewell, J.
Kinsey, W. Barnes
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Middleton, W., Westminster Chambers, S.W.
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*Pratt, M., Brigstock House, Thornton Heath, Croydon
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Southport, The Mayor and Corporation of
Stafford, Mayor and Corporation of
Stidder, J. C., Southwark Bridge Road
Thomas, Kennington, 47, Colmore Road, Birmingham
Tottenham Sanitary Association, High Cross, Tottenham
West Bromwich Improvement Commissioners, The
Wallace, Miss, 6, Hyde Park Gardens.
Yorkshire Salmon Fishery Board, 22, Albemarle Crescent, Scarborough. The Chairman and Honorary Secretary.

BYE-LAWS.

Election of Fellows, Members, Associates, Honorary Members, and Honorary Foreign Associates.

1. The Institute shall consist of Fellows, Members, Associates, Annual and Life Subscribers, Honorary Members, and Honorary Foreign Associates. The government and management of the Institute shall be vested in the Council, under the control of the bye-laws, and of the Resolutions of Special General Meetings.

2. Fellows shall be elected by ballot by the Council, and shall include scientific men of eminence, persons of distinction as Legislators or Administrators and others, who have done noteworthy Sanitary work.

3. No person shall be balloted for as a Fellow unless his name has been duly proposed, seconded, and approved by a majority at a previous regular Meeting of the Council, and his name and address, together with the names of the proposer and seconder inserted in the summons convening the Meeting at which such ballot shall take place.

4. Fellows shall be elected by a majority of the Council present at the Meeting at which their names are brought forward for election, and the votes shall be taken by ballot.

5. Any Candidate for membership with the Institute shall procure a recommendation signed by three Fellows or Members, according to Form 1 in the Appendix.

6. The names of Candidates for membership, together with their addresses and the names of the Fellows or Members recommending them, shall be inserted in the summons convening the Meeting of Council at which such candidates are brought forward for election.

7. All Members (except those who have passed the examination and received the certificate of competence for Local Surveyors) shall be elected by a majority of the Council present at the Meeting at which their names are brought forward for election, and the votes shall be taken by ballot.

8. Persons who have obtained the certificate of competence for Local Surveyors are entitled to admission as Members without ballot.

9. Every Candidate for admission as an Associate of the Institute shall procure a recommendation, signed by two Fellows, Members, or Associates, according to Form 2 in the Appendix.

10. The names of Candidates, together with their addresses and the names of the persons recommending them shall be inserted in the summons convening the Meeting of Council at which such candidates are to be brought forward for election.

11. All Associates (except those who have passed the examination and received the certificate of competence for Inspectors of Nuisances) shall be elected by a majority of the Council present at the meeting at which their names are brought forward for election, and the votes shall be taken by ballot.

12. Persons who have obtained the certificate of competence for Inspectors of Nuisances are entitled to admission as Associates without ballot.

13. The Council shall have the power to elect from time to time distinguished personages as Honorary Members of the Institute, without payment of fees or subscriptions.

14. The Honorary Members elected in each year shall not exceed five in number.

15. The Council shall have power to elect from time to time as Honorary Foreign Associates, gentlemen who have promoted the advancement of Sanitary Science, without the payment of fees or subscriptions.

16. When a person shall have been elected a Fellow, Member, or Associate, the Secretary shall inform him thereof by letter, as soon as possible, in the terms of the Form 3 in the Appendix; and shall at the same time forward to him a copy of the bye-laws of the Institute, together with a copy of the Form 4 in the Appendix.

17. Every person so elected shall pay his admission fee and first annual contribution, and shall return the Form 4 duly signed, within three calendar months after the day of his election, otherwise his election shall be void; but the Council shall have the power, in particular cases, of extending the period of such payment and signature respectively.

18. Notice shall be sent by the Secretary to all Honorary Members, and Honorary Foreign Associates, on their election.

19. The names of all Fellows, Members, Associates, Honorary Members, and Honorary Foreign Associates, elected by the Council, shall be entered on the minutes of the Meeting at which they were elected, and a register of the same shall be kept by the Secretary, and also a list of the Subscribers.

20. Honorary Members and Honorary Foreign Associates shall have forwarded to them, by the Secretary, on their election, a copy of the Diploma of the Institute, signed by the President, the Chairman of Council and the Registrar, in the Form 5 in the Appendix.

21. Fellows, Life Members, and Life Associates are entitled to a Diploma, on application to the Secretary.

22. Fellows, Members, and Associates, having occasion to designate themselves as belonging to the Institute, shall state the class to which they belong as follows, viz.:—Fellow San. Inst., Mem. San. Inst., Assoc. San. Inst.

23. A Special Meeting of the Council, consisting of the Chairman

of Council and not less than ten members, shall have power to remove any Fellow, Member, or Associate from the Institute, upon receiving a requisition to that effect, with the reasons stated, signed by not less than twenty Fellows or Members of the Institute.

SUBSCRIBERS.

24. Persons of either sex may become Subscribers without election or ballot. (*See* Appendix. Form 6.)

25. The amount of the Annual Subscription shall be One Guinea.

26. Annual Subscribers shall be entitled to attend the Anniversary and Ordinary Meetings, and to take part in the same, with free admission to all Congresses, Conversazioni, and Exhibitions held by the Institute, and to make use of the Library, when formed.

27. Donors of Ten Guineas and upwards are Life Subscribers.

CONTRIBUTIONS TO THE FUNDS.

28. Each Fellow shall pay £10. 10*s* on taking up the Fellowship, which shall entitle him to all the privileges of the Institute for life, together with a copy of all publications issued by the Institute.

29. Every Member shall pay an Admission Fee of £3. 3*s*, except Medical Officers of Health and Medical Men holding certificates in Sanitary Science from any University or Medical Corporation, or persons holding the certificate for Local Surveyors granted by the Institute.

30. Each Member shall pay £2. 2*s* per annum, except those who have become Life Members, or who have passed the examination for Local Surveyors. Members shall be entitled to all the privileges and advantages of the Institute, together with a copy of all publications issued by the Institute, so long as they continue to pay their subscription.

31. Persons who have passed the examination for Local Surveyors may become Members for Life on payment of £5. 5*s*.

32. Members elected previous to the 12th December, 1878, shall only be liable to pay the same Subscription as at their election.

33. Every Associate shall pay an Admission Fee of £2. 2*s*, except those holding the certificate of Inspector of Nuisances granted by the Institute.

34. Each Associate shall pay £1. 1*s* per annum, except those who have passed the examination for Inspector of Nuisances. Associates shall be entitled to all the publications issued by the Council so long as they continue to pay their subscriptions.

35. Persons who have passed the examination for Inspectors of Nuisances may become Associates for Life on payment of £3. 3*s*.

36. All yearly Subscriptions shall be due in advance on the 1st of January in each year. The Subscription shall become due on election.

37. Members, Associates, and Subscribers may commute their Annual Subscription, and become Life Members, Life Associates, and Life Subscribers on payment of £10. 10*s*.

38. If the Annual Subscription of any Member or Associate shall be in arrear for two years, the Secretary shall give notice thereof to

the Member or Associate; and if the said Subscription shall continue in arrear at the expiration of three months after such notice, the Council (having through the Secretary given the defaulting Member or Associate due notice of their intention) shall have the power to strike the name of such Member or Associate off the Register, and he shall thereupon cease to be a Member or Associate of the Institute; but shall remain liable for any arrears of Subscription which shall be due at the date of his so ceasing to be a Member or Associate.

39. Any Member or Associate desirous of withdrawing from the Institute must give notice in writing to that effect to the Secretary; and on payment of all Subscriptions and arrears which may be due from him up to that period, he shall henceforth cease to be a Member or Associate.

40. Any person whose name shall have been struck off under the foregoing bye-law may, on payment of his arrears, be re-admitted by the Council.

41. No person who shall have ceased to belong to the Institute, either by resignation or otherwise, shall have any claim to have any part of his Entrance Fee or Subscription returned, neither shall he retain any interest in the property belonging to the Institute.

Election of Council and Officers.

42. The President, the Vice-Presidents, the Examiners, the Registrar, the Judges and the Curator of the Exhibitions, the Honorary Foreign Secretaries and the Secretary, shall be elected by the Council.

43. The Council, the Trustees, the Treasurer, and the Auditors shall be elected by the Fellows and Members at the Annual General Meeting.

44. The Council shall prepare a list of persons whom they nominate as eligible to fill the vacancies created by the retiring Members of Council and of the gentlemen they recommend as eligible to fill the offices of Trustees, Treasurer and Auditors.

45. The list so prepared shall be the balloting list, and a copy shall be sent to every Fellow and Member at least seven days before the Annual General Meeting.

46. The election shall be by ballot by the Fellows and Members, and shall take place in the following manner:—

Previous to the commencement of the ballot, the Meeting shall choose two or more Fellows or Members as Scrutineers, who shall receive the balloting lists and report the result of the ballot to the Chairman.

Every Fellow and Member intending to vote at the election may, if he think fit, erase any name or names from the balloting list, and may substitute in the place thereof the name or names of any other person or persons, in accordance with the conditions laid down in Bye-law 51, and shall hand in to the Scrutineers such balloting list as aforesaid either with or without such erasure and substitution of names.

On the receipt of such list from the voter, if the voter's qualification be not objected to, or if objected to and the Chairman shall be satisfied that the voter is duly qualified, the Scrutineers shall deposit such list in the balloting-box. The decision of the Chairman in such matter shall be final.

Any balloting list containing a greater number of names proposed for any office than the number to be elected to such office, shall be absolutely and wholly void, and shall be rejected by the Scrutineers.

If the votes in any case be equal, the Chairman shall give the casting vote.

The ballot shall commence not sooner than four o'clock P.M., and shall continue open for one hour.

The President and Vice-Presidents.

47. The President shall be elected by the Council at a Meeting specially convened for that purpose, and shall be a person distinguished for the interest he has taken in the promotion and advancement of Sanitary Science.

48. The President shall be *ex-officio* a member of the Council and of all Committees, and shall take the chair by right at all meetings of the Institute, of the Council, and of the Committees, at which he is present.

49. The Council shall have power to elect as Vice-Presidents persons distinguished for the interest they have taken in Sanitary work.

50. The Vice-Presidents shall be elected annually, and shall not exceed six in number, and shall be *ex-officio* members of the Council.

The Council.

51. The Council shall consist of twenty-four Fellows and Members (in addition to the *ex-officio* Members). Not less than two-thirds of these twenty-four shall be Fellows.

52. The President, Vice-Presidents, Trustees, Treasurer, and Registrar shall be *ex-officio* Members of Council.

53. The Council shall have the direction and management of the concerns of the Institute, the appointment and dismissal of the paid officers and attendants, and the prescribing of their respective duties, subject to the control of the bye-laws, and of all resolutions of Meetings which have been duly summoned and held in accordance with the bye-laws, and which resolutions have been duly entered on the Minutes and confirmed.

54. Any casual vacancies occurring in the Council may be filled up by the remaining Members thereof.

55. At each Annual General Meeting one-fourth of the twenty-four elected Members of the Council shall retire, and shall not be eligible for re-election for one year. The Council shall submit to the Annual Meeting the names of the six gentlemen whom they recommend to fill up the vacancies.

56. The Secretary shall forward a printed list, with his initials attached, to each Member of Council (including *ex-officio* members) of the names of the existing *elected* Members of Council, and the number of attendances of each Member, at least seven days prior to the ordinary Monthly Meeting of the Council in March. Each Member of Council present at such Meeting shall strike off from the list the names of six Members whom he suggests for retirement, and shall deliver the same, enclosed in a blank envelope, to the Chairman, who shall announce the names of the retiring Members.

57. Upon such announcement the Members present shall proceed by ballot to choose six other Fellows or Members to be recommended to the Annual General Meeting, to take the places of the retiring Members.

58. At the first Meeting after their election the Council shall proceed to elect, by ballot, a Chairman and Vice-Chairman who shall be *ex-officio* Members of all Committees.

59. The Chairman of the Council after two years' service shall not be re-eligible to the office for at least one year.

60. All matters requiring immediate decision, and occurring between the date of one Council Meeting and another, shall be decided by the Chairman of the Council at his discretion, subject to confirmation at the next Meeting of Council.

61. The Council shall meet on the fourth Thursday in every month, except during the months of August and September.

62. Five Members of the Council shall constitute a quorum.

63. All questions shall be decided in the Council by vote unless a ballot is provided for or demanded. The Chairman shall have a second or casting vote.

64. At each Meeting of Council the Minutes of the previous Meeting shall be read, and, if approved as correct, shall be signed by the Chairman of the Meeting.

65. The Minutes of each Annual and Special General Meeting shall be read and signed in a similar manner by the Chairman presiding at the first Meeting of Council after such Annual or Special General Meeting.

66. A Special Meeting of the Council shall be summoned on the Secretary receiving a notice to do so signed by the Chairman or any five Members of Council, describing the business intended to be brought forward. Seven days' notice, at least, shall be given of any Special Meeting of Council; such notice to state particularly the business for which the Special Meeting has been summoned, and no other business to be entered upon.

67. All Committees shall be appointed by the Council.

68. No act, order, or resolution of any Committee shall bind the Institute, unless it be done or made by the direction and authority of the Council or be ratified by them.

69. A statement of the funds of the Institute and of the receipts and payments during the past year shall be made up to the 31st of December, under the direction of the Council; and after having been verified and signed by the Auditors shall be laid before the Annual General Meeting.

70. The Council shall draw up a yearly report on the state of the Institute, which shall be read at the Annual General Meeting.

71. The Council shall have power to elect as Corresponding Members of Council, Fellows and Members of the Institute who have distinguished themselves in the cause of Sanitary Science and aided in promoting the objects of the Institute.

72. The names of all Corresponding Members of Council shall be entered on the Minutes of the Meeting at which they were elected, and shall be printed in the Calendar.

73. As early as possible in each year the Council shall cause to be published a Calendar of the Institute for the year, a copy of which, together with all other Reports of proceedings and catalogue of Exhibitions, shall be supplied free of charge to all Fellows, Members, Associates, and Subscribers.

74. The Council shall arrange for the publication of the papers read at the Meetings, or of such documents as may be calculated to advance Sanitary knowledge; and they shall have power to make such arrangements for carrying into effect the bye-laws, and for the general management of affairs, as in their opinion may from time to time be necessary.

The Meetings.

75. The Meetings of the Institute shall be as follows :—

- 1*st*. The Annual General Meeting of Fellows and Members only.
- 2*nd*. Special General Meetings of Fellows and Members only, for the purpose of making, altering, and establishing Bye-laws and Regulations, or for any other special business for which such Meeting may be convened.
- 3*rd*. The Anniversary Meeting.
- 4*th*. Ordinary Meetings.

76. The Annual General Meeting shall be held in May in each year, at 4 o'clock in the Afternoon, to receive and deliberate upon the Report of the Council on the state of the Institute, with the annual statement of the Accounts, and to elect the Council and Officers for the ensuing year.

77. No question shall be discussed, or motion be made, at the Annual General Meeting, the Anniversary Meeting, or Ordinary Meetings, relative to the direction and management of the concerns of the Institute; such direction and management being vested in the Council, under the control of the bye-laws, and of the Resolutions of Special General Meetings.

78. The Council may at any time call a Special General Meeting of Fellows and Members for a specific purpose relative to the direction and management of the concerns of the Institute; and the Council shall at all times call such Meeting within fourteen days on a requisition in writing, signed by twenty, being either Fellows or Members, specifying the nature of the business to be transacted.

79. A notice shall be sent to those Fellows and Members who reside in the United Kingdom, at least seven days before the time

appointed by the Council for such Special General Meeting; and the notice shall specify the nature of the business to be transacted and no other business shall be transacted at that meeting. All Fellows and Members shall have a right, subject to the provision of Bye-law No. 85, to attend and vote, and twenty shall constitute a quorum.

80. The Fellows and Members of the Institute may from time to time, by resolution of a Special General Meeting confirmed at a subsequent Special General Meeting held not less than seven and not more than fourteen days after the former Meeting, make, alter, or repeal such bye-laws as they may think fit.

81. At all General Meetings the Chair shall be taken by the President, or, in his absence, by one of the Vice-Presidents, or by the Chairman of the Council, or by some Member to be chosen by the Meeting.

82. The Chairman shall have a second or casting vote at all General Meetings; and in all matters in dispute his decision shall be final.

83. Motions made at any General Meeting of the Institute shall be in writing, and signed by the Mover and Seconder.

84. All Fellows and Members are entitled to take part in the Annual General Meeting, subject to the provisions contained in these bye-laws, and ten shall form a quorum.

85. No Fellow or Member, whose Fees or Subscriptions are in arrear, shall be entitled to be present, to debate, or to vote at any General Meeting.

86. The Anniversary Meeting shall be held on the second Thursday in July in each year, to commemorate the formation of the Institute, when an address shall be delivered, to be called the "Annual Address."

87. The presentation of the Medals and Certificates of Merit awarded to successful Exhibitors shall be made at the Anniversary Meeting.

88. No business shall be transacted at the Anniversary Meeting except the delivery of the Address and the discussion arising thereupon.

89. All Fellows, Members, Associates, Honorary Members, Honorary Foreign Associates, and Annual and Life-Subscribers, shall be entitled to attend and to take part in the proceedings at the Anniversary Meeting, and at the Ordinary Meetings.

90. Every Fellow or Member shall have the privilege of introducing one stranger, to be present at the Anniversary Meeting, or at the Ordinary Meetings of the Institute, on writing his name in a book provided for that purpose, or sending with him a card signed with his name, according to a form provided.

91. The Council shall arrange, at their first Meeting in October a programme of the Ordinary Meetings to be held during the Session for the reading and discussion of papers, and the delivery of Lectures and Addresses.

92. A copy of such programme shall be supplied to every Fellow, Member, Associate, and Subscriber.

93. The Council shall appoint a Committee of Referees, to whom all papers shall be referred before being read.

94. The business of the Ordinary Meetings of the Institute shall be conducted as nearly as possible in the following order:—

1. The Minutes of the preceding Meeting to be read, and after having been approved as correct, to be signed by the Chairman.
2. Communications from the Council to be brought forward.
3. A List of the names of those persons who have joined the Institute since the previous Ordinary Meeting to be read.
4. Original Communications to be read and discussed.

The Examiners and Examinations.

95. A Board of Examiners shall be appointed once a year by the Council to carry out the Examinations for Local Surveyors and Inspectors of Nuisances, and a Certificate shall be granted to successful Candidates, signed by the Examiners, according to Form 7 in the Appendix.

96. The times and places for holding the Examinations shall be determined by the Council.

97. The names of the Examiners, the syllabus of subjects for Examination, and the printed questions set at each Examination during the year, together with the list of successful candidates, and full particulars relating to the Examinations, shall be published in the Annual Calendar of the Institute, under the authority of the Council.

98. The fees charged for the Examination and Certificate shall be as follows:—For Local Surveyors, Five Guineas; for Inspectors of Nuisances, Two Guineas. Unsuccessful Candidates are entitled to present themselves a second time for one fee.

The Registrar.

99. The Registrar shall sign all certificates and diplomas, and shall keep the Register of persons certificated by the Institute. In concert with the Board of Examiners he shall prepare an Annual Report of the Examinations to be presented to the Council.

The Treasurer and Auditors.

100. The Treasurer shall receive all money due to the Institute and shall pay it into a bank in London appointed by the Council.

101. All moneys, except investments, shall be kept at such bank in the name of the Institute.

102. The Treasurer shall make all payments ordered by the Council, by cheque signed by himself and countersigned by the Secretary.

103. He shall cause an account to be kept of all receipts and payments.

104. No cheque shall be drawn without a previous vote of the Council, except such sums as may be required for petty cash.

105. All receipts for Fees and Subscriptions paid to the Institute shall be signed by the Treasurer or the Secretary.

106. The accounts shall be audited once a year by the Auditors elected by the Annual General Meeting.

107. The Auditors shall have access at all reasonable times to all books and accounts of the Institute, and shall sign the Annual Statement of Accounts before it is submitted to the Council.

The Secretaries.

108. The Council shall have power to appoint any gentlemen at their discretion as Honorary Foreign Secretaries.

109. The Secretary shall be appointed by the Council, and shall receive such remuneration and be subject to such notice as the Council may from time to time think fit.

110. He shall give security to the satisfaction of the Council, and he shall not be engaged in any other business or profession whatever.

111. The Secretary shall, under the direction of the Council, conduct the correspondence of the Institute, attend all Meetings of the Institute, of the Council (and of the Committees when required); take Minutes of the proceedings of such Meetings, and read the Minutes of the preceding Meetings.

112. He shall issue all notices of Meetings, and shall prepare, under the direction of the Council, an Annual Report of the state of the Institute. He shall have the superintendence of all persons employed and paid by the Council under him, and shall conduct the ordinary general business of the Institute.

113. The Secretary shall attend to the collection of the Subscriptions; he shall prepare the statement of the expenditure of the funds, and present all accounts to the Council for inspection and approval.

114. The Secretary shall prepare lists when required of those Members whose Subscriptions are in arrear and report the same to the Treasurer.

115. He shall, under the direction of the Treasurer, keep the accounts of the Institute.

116. The Secretary shall attend all Meetings of the Board of Examiners, shall take the Minutes of such Meetings and read the Minutes of preceding Meetings. He shall issue all notices relating to Examinations.

The Library.

117. With a view to the formation of a Library and Collection, all Fellows, Members and Associates are expected, within twelve months after their election, to deliver to the Council an original paper on some subject connected with Sanitary Science, or to make a donation to the Library or Collection.

118. The Library shall be under the direct control and government of the Council.

119. A Catalogue shall be prepared and kept of all books belonging to the Library.

120. The name of the donor shall be entered in every book presented to the Institute.

The Exhibitions.

121. Previous to the holding of any Exhibition by the Institute, the Council shall issue a prospectus containing the Rules, Regulations, and Conditions, with full particulars relating to such Exhibition.

122. A Catalogue of each Exhibition shall be published under the direction of the Council.

123. The Judges shall make their Report exclusively to the Council by whom the Medals and Certificates of Merit shall be awarded, and such Medals and Certificates shall be presented at the Anniversary Meeting. (*See* Appendix. Form 8.)

The Congresses.

124. The Council shall hold Congresses at such times and places as they may deem most convenient, at which addresses shall be delivered and papers read and discussed, upon subjects of general interest relating to Sanitary Science.

125. The Council shall issue a prospectus previous to the holding of each Congress, setting forth the particulars relating to such Congress.

126. At each Congress the Council shall issue "Congress Tickets," entitling the holder to admission to all the Meetings held in connection with the Congress. The price of the "Congress Tickets" shall be Half-a-Guinea each.

The Property of the Institute.

127. The property and effects of the Institute of what kind soever shall be vested in three Trustees for the use of the Institute, and in furtherance of the objects for which it has been established.

128. Under no pretence whatever shall the property and effects, or the income or revenue of the Institute derived from the voluntary contributions or otherwise howsoever, be applied in making any dividend, gift, division or bonus unto or between any one belonging to the Institute, excepting in the case of the fees received on account of the Examinations.

129. Every paper and contribution presented to the Institute shall be considered the property thereof, unless there shall have been some previous arrangement to the contrary, and the Council may publish the same in any way and at any time they may think proper to do so.

130. Should the Council refuse or delay the publication of any paper beyond a reasonable time, the author thereof shall have a right to copy the same, and to publish it as he may think fit, having previously given notice in writing to the Secretary of his intention to do so. No person shall publish or give his consent for the publication of any communication presented and belonging to the Institute without the previous consent of the Council.

Donations and Bequests.

131. The names of all persons who have presented any additions to the Library or to the Collection of Plans, Models, etc., or who have made any voluntary contribution to the funds of the Institute, shall be recorded and published as benefactors to the Institute.

132. Every person desirous of bequeathing to the Institute any Manuscripts, Books, Maps, Plans, Drawings, Instruments, or other personal property, is requested to make use of the following form in his will:—

Form of Bequest.

"I give and bequeath to the Sanitary Institute of Great "Britain in London [*here enumerate and particularize the effects "or property to be bequeathed*]. And I hereby declare that the "receipt of the Treasurer of the said Institute for the time being "shall be an effectual discharge to my executors for the said legacy "or bequest."

APPENDIX.

FORM 1.

SANITARY INSTITUTE OF GREAT BRITAIN.

FORM OF APPLICATION FOR ADMISSION OF MEMBERS.

(This Form must be signed by at least Three Fellows or Members of the Institute.)

Name ____

Place of Residence ____

Title, Profession, or Occupation

____

being desirous of becoming a Member of the SANITARY INSTITUTE OF GREAT BRITAIN, we, the undersigned, do recommend him as in every respect a proper person to be elected a Member of the Institute.

____

____

____

Dated this ____________ day of ____________ 18 .

This application was read on the ________________________

and balloted for on the ________________________

FORM 2.

SANITARY INSTITUTE OF GREAT BRITAIN.

FORM OF APPLICATION FOR ADMISSION OF ASSOCIATES.

(This Form must be signed by at least Two Fellows, Members, or Associates of the Institute.)

Name ____

Place of Residence ____

Title, Profession, or Occupation

____

being desirous of becoming an Associate of the SANITARY INSTITUTE OF GREAT BRITAIN, we, the undersigned, do recommend him as a proper person to be elected an Associate of the Institute.

Dated this ____________ day of ____________ 18 .

____

____

This application was read on the ________________________

and balloted for on the ________________________

FORM 3.

SANITARY INSTITUTE OF GREAT BRITAIN.

______________ 18 .

Sir,

I have the honour to inform you that you have this day been elected a ______________ of the Sanitary Institute of Great Britain. I forward you herewith a copy of the Bye-laws of the Institute, together with a form which you are requested to sign and return to me with the admission fee and annual subscription, amounting to ________________, within three months of the date of your election.

I am, Sir, &c.,

____

Secretary.

FORM 4.

I, the undersigned, having been elected a ____________________ of the Sanitary Institute of Great Britain, do hereby promise that I will be governed by the Bye-laws and Regulations of the said Institute, as they are now formed, or as they may hereafter be altered or amended; that I will advance the objects of the said Institute as far as shall be in my power; and that I will attend the Meetings thereof as often as I conveniently can. Provided, however, that whenever I shall signify in writing to the Secretary that I am desirous to withdraw my name therefrom, I shall (after the payment of any arrears which may be due by me at that period, and after giving up any Books, Papers, or other property belonging to the Institute, in my possession or entrusted to me), be free from this obligation.

Witness my hand this __________ day of ______________ 18 .

FORM 5.

Diploma.

This is to Certify
That at a Meeting of the Council of
THE SANITARY INSTITUTE OF GREAT BRITAIN duly convened

____

was enrolled as

____

And this our Diploma was duly conferred upon him.
Witness our hands this day of 18 .

____________________________ *President.*

____________________________ *Chairman of Council.*

____________________________ *Registrar.*

FORM 6.

SANITARY INSTITUTE OF GREAT BRITAIN.

FORM OF APPLICATION FOR ENROLMENT OF SUBSCRIBERS.

To the Council

I desire to be enrolled* ____________________________

____

of the SANITARY INSTITUTE OF GREAT BRITAIN.

Name ____________________________________

Title, Profession, or Occupation

____

Address ____________________________________

Date. ____________________________________

* State here whether as Life Subscriber or Annual Subscriber.

Donors of Ten Guineas, or upwards, are Life Subscribers. Subscribers of One Guinea are Annual Subscribers.

FORM 7.

Certificate

of

THE SANITARY INSTITUTE OF GREAT BRITAIN

________________________ having been examined by the Officers of the Board appointed for that purpose and in their opinion having been found competent, as regards his Sanitary knowledge, to discharge the duties of

____

The Council of the SANITARY INSTITUTE of GREAT BRITAIN, at a Meeting duly convened, ordered this certificate to be granted.

Witness our hands this ________ day of ________ 18 .

____

____

____________________________________ *Examiners.*

____

____

____________________ *Registrar.*

FORM 8.

Certificate of Merit

Awarded by the Council of THE SANITARY INSTITUTE OF GREAT BRITAIN.

To

____

For

____

Exhibited at the Exhibition of the Institute, held at

____

By Order.

____

Secretary.

INDEX TO BYE-LAWS.

G. NORMAN AND SON, PRINTERS, 29, MAIDEN LANE, COVENT GARDEN, LONDON.

SANITARY INSTITUTE OF GREAT BRITAIN.

Abstract of Cash Receipts and Payments for the year ending 31st December, 1879.

	£	s.	d.	£	s.	d.
To Balance at Bankers and in hand, 1st Jan., 1879				91	17	1
,, *Fees Received:*						
Fellows	231	0	0			
Associates	19	19	0			
Life Members	24	3	0			
Entrance Fees	9	9	0			
Examination Fees	9	7	6			
				293	18	6
To Annual Subscriptions				210	9	0
,, *Donations*				5	4	0
,, *Exhibitions:*						
Croydon	161	1	4			
Stafford	65	9	11			
				226	11	3
				£827	19	10

	£	s.	d.	£	s.	d.
By Office Expenses:						
Rent	36	0	0			
Salaries and Wages	131	4	4			
Postage, Telegrams, and Carriage	67	14	0			
Petty Expenses	11	3	7			
				246	1	11
By General Expenses:						
Stationery and Printing	82	0	6			
Advertising	11	11	8			
Examination Expenses	10	10	0			
Experiments	10	4	1			
				114	6	3
By Balances at Bankers and in hand, 31st December, 1879:						
Cash at Bankers	188	2	7			
Exhibitions (Separate Account)	226	11	3			
Cheques, &c., paid to Bankers subsequent to 31st December, 1879	52	10	0			
Petty Cash	0	7	10			
				467	11	8
				£827	19	10

QUILTER, BALL, CROSBIE, GLEGG & WELTON, *Public Accountants,*
5, Moorgate Street, E.C.

20th May, 1880.

l:fj, 18 vols